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USAID FROM THE AMERICAN PEOPLE

APEC WOMEN IN STEM

A FRAMEWORK FOR DIALOGUE, LEARNING, AND ACTION

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Contents

ACRONYMS

AASSA	Association of Academies and Societies of Sciences in Asia
ABAC	APEC Business Advisory Council
APEC	Asia-Pacific Economic Cooperation
GEDI	Gender Equity and Social Inclusion
HRDWG	Human Resources Development Working Group
IIE	Institute for International Education
NASA	National Aeronautics and Space Administration
NGO	Non-Government Organization
PISA	Program for International Student Assessment
PPSTI	Policy Partnership on Science, Technology and Innovation
PPWE	Policy Partnership on Women and the Economy
PSU	Policy Support Unit
OECD	Organization for Economic Cooperation and Development
R&D	Research and Development
SAGA	STEM and Gender Advancement
SME	Small and medium-sized enterprises
STEM	Science, Technology, Engineering, and Mathematics
STEAM	Science, Technology, Engineering, Art/Design, and Mathematics
STEMM	Science, Technology, Engineering, Mathematics, and Medicine
STI	Science, Technology, and Innovation
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
US-ATAARI	US-APEC Technical Assistance to Advance Regional Integration
WE-APEC	Women's Entrepreneurship in APEC initiative
WEF	Women in the Economy Forum (APEC)
WiT	Women in Transportation

EXECUTIVE SUMMARY

The APEC Women in Science, Technology, Engineering and Math (STEM) initiative arises from the APEC Women in the Economy Dashboard, a project of APEC's Policy Partnership on Women and the Economy. Under the premise that meaningful, consistently maintained data should underpin all of APEC's work to address the deficits faced in women's economic participation, the Dashboard is a ground-breaking tool that tracks key metrics across the Asia-Pacific region. In 2015, the APEC Secretariat's Policy Support Unit (PSU) reported for the first time on the Dashboard's 75-plus indicators of women's economic empowerment. The report revealed significant gaps across APEC in both the education and career advancement of women in the STEM fields. Specifically, although women increasingly study and work in the life sciences disciplines, they are vastly outnumbered by men in degree programs relating to engineering and technology. In STEM research and R&D jobs generally, their presence similarly does not come close to that of men.

The under-representation of women in STEM fields – not only as students and researchers, but also as managers, leaders, and entrepreneurs – significantly hinders sustainable economic growth and prosperity throughout APEC. The availability of skilled workers in STEM fields relates closely to the ability of economies to participate as innovators in the knowledge economy and to compete on a global scale. And, for all workers, the chance not only to prepare for and embark on a career in STEM, but also to grow and flourish in STEM professions, is a path that offers many rewards. In most economies, these include job opportunities (both within and beyond STEM), professional challenges, and comparatively high salaries.

Accordingly, based on the Dashboard's findings, as well as on additional data reinforcing the fact of under-representation of women in science and technology jobs, the United States elected to champion Women in STEM as a means of improving APEC's performance in this area. In February 2016, U.S. Ambassador-at-Large for Global Women's Issues Cathy Russell launched the multi-year Women in STEM initiative, beginning with a study of active initiatives and best practices in the APEC region. Through an array of research and consultation activities, the US-APEC Technical Assistance to Advance Regional Integration (US-ATAARI) project explored conditions and experiences across all 21 APEC economies. To date, scores of individuals and institutions have participated in this inquiry, including through interviews and consultations; an APEC-wide qualitative survey; a workshop held alongside APEC's Women and the Economy Forum in June 2016; and a Women in STEM forum, held alongside APEC's Education Ministerial in October 2016. This report represents a shared vision for how APEC and its member economies can most effectively promote and support Women in STEM.

The challenge and the opportunities

For most women and girls, forging a career in STEM remains a difficult path to follow. Although consistent data across all 21 APEC economies is sparse and incomplete, it is clear that, throughout their lives, women encounter stereotypes and other cultural constraints that discourage them from aspiring to careers and leadership in STEM and that reinforce expectations that their primary roles are in the home. In early education, teachers often lack the resources and confidence to model STEM as an exciting path for both girls and boys. Gender gaps in high school math and science attainment and achievement are narrowing, but still common. At university, women are less likely than men to pursue STEM degrees, particularly in engineering and, in many economies, computer science. When entering the workforce, women face overt and implicit bias about their qualifications, a constraint that stays with them as they take on jobs traditionally held by men, seek to engage in research, and pursue advancement in their fields. And, at all stages, women who come from minority or disadvantaged communities experience a double burden: they confront not only gender stereotypes, but attitudes, practices, and a lack of resources that may coalesce to hold them back even further.

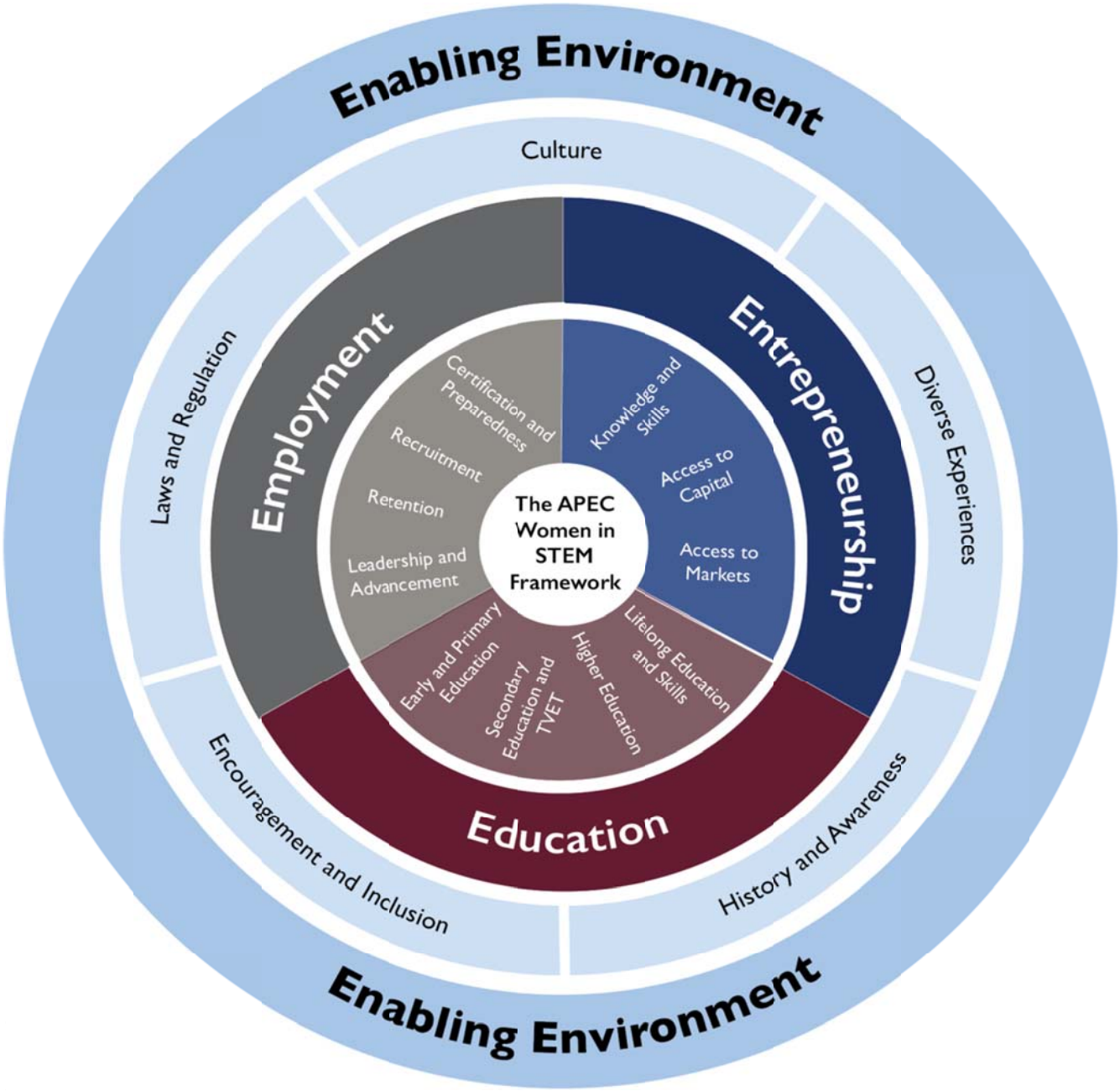
Nonetheless, for those women who do study STEM disciplines and seek STEM-related work following their formal educations – whether as secondary students preparing for technical careers, or as university graduates in the STEM fields – governments and companies have begun to invest in their success. Across APEC, economies are developing policies and programs that encourage women to seek STEM jobs or pursue research opportunities and that help employers improve conditions for their retention and advancement. Many STEM firms actively encourage growth and resilience among their women employees, such as through mentorship programs, diverse selection and promotion panels, and more flexible workplaces.

Still, women in STEM professions continue to be less likely than men to progress in their jobs, more likely to take time off for child-rearing, and, when returning to the workforce, less likely to remain in their chosen fields. By gravitating toward academia and government, rather than industry and entrepreneurship, qualified women also tend to earn less money over the course of their careers. Especially in the "non-traditional" areas of engineering or technology, women are more likely than men to leave their STEM jobs after just a few years, never to return. Women's leadership in certain areas of STEM is increasing – again, particularly in the life sciences and medicine – but women remain dramatically under-represented as leaders in engineering and computer science. Women constitute just a small percentage of STEM entrepreneurs, and their enterprises receive less start-up funding and sustaining investment than those launched by men.

The APEC Women in STEM framework

Against this backdrop, the APEC Women in STEM initiative establishes a foundation of shared experiences so that economies can learn from one another and work together to hasten the pace of change. From this period of research, dialogue, and synthesis, the Women in STEM framework emerged, organizing the challenges across key issues of (1) the Enabling Environment; (2) Education; (3) Employment; and (4) Entrepreneurship. Within each of these areas, a number of sub-pillars also became clear.

Figure 1 The APEC Women in STEM Framework



By organizing the world of Women in STEM into this framework, stakeholders can consider the range of issues affecting the hiring, retention, and advancement of women in these fields and better target programs, thus ensuring actions are connected to the broader STEM ecosystem. The Women in STEM initiative now challenges all 21 economies, first, to intensify their efforts to prepare girls and women to enter STEM professions, and, second, to encourage STEM employers and investors to build strong environments for women's success. As illustrated through this study, a wealth of initiatives are already taking place across the region. APEC economies have a great deal to learn from one another.

Following a description of the framework – which for each section identifies many opportunities for economies, educators, and employers to improve conditions for women in STEM – this report sets forth a number of recommendations for APEC-wide consideration. These include developing and sharing APEC-wide models for STEM education, employment, and advancement policies. In addition, this report recommends that APEC institutions with a direct interest in Women in STEM, including the Human Resources Development Working Group and the Policy Partnership on Science, Technology, and Industry, prioritize and act on specific concerns and opportunities associated with Women in STEM. Moreover, as contemplated by the Dashboard, it is suggested that APEC continue promoting among economies the importance of sex-disaggregated data within all social and economic functions, including in the STEM fields.

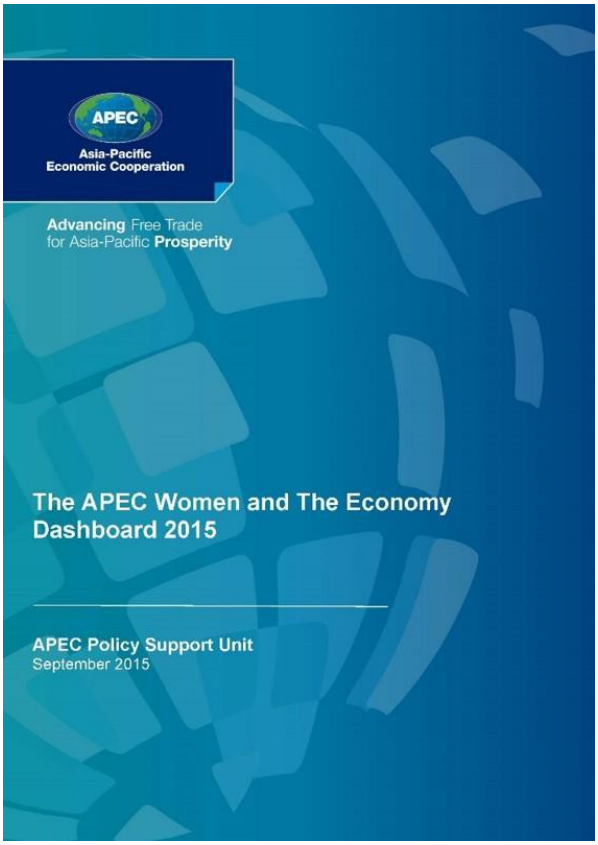
After formal endorsement of the Women in STEM framework, anticipated in November 2016, economies may turn to the implementation of the initiative through economy-specific activities and cross-APEC opportunities that address gaps and spur the application and continued sharing of best and promising practices in the region.

INTRODUCTION

The APEC Women in STEM initiative is a direct outcome of the Women and the Economy Dashboard, a project of APEC's Policy Partnership on Women and the Economy (PPWE), the objective of which is to identify data-driven capacity-building priorities across APEC. Since 2014, APEC economies have committed to championing key factors of women's economic advancement as benchmarked by the Dashboard. Among the key gaps the Dashboard identified across the region promoting and measuring change over time, the United States elected to advance Women in STEM.

METHODOLOGY

In February 2016, U.S. Ambassador-at-Large for Global Women's Issues Cathy Russell launched the Women in STEM initiative at the APEC Business Advisory Council (ABAC) Women's Forum, held in San Francisco, California. The initiative would begin, she announced, with a study that helps APEC economies and the private sector better understand the success of work in this area by highlighting active initiatives and best practices in the region, identifying gaps in regional efforts, and providing policy recommendations on how APEC economies can close these gaps. (U.S. Dept. of State, Press Release, February 29, 2016).



For the next several months, US-ATAARI explored both the "pipeline" of women into STEM fields *or* into jobs requiring STEM skills, along with conditions impacting women in STEM at key points in their careers. A great many individuals and organizations supported this study. US-ATAARI sought and received input from scores of policy-makers and public servants, private-sector representatives, educators, researchers, scientists, mathematicians, tech-workers, students, and more. Between March and August 2016, US-ATAARI conducted a written survey across APEC that produced detailed information about policies and practices from governments and companies in 15 economies– Australia, Canada, Chile, People's Republic of China, Japan, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Singapore, Chinese Taipei, Thailand, and the United States. In June 2016, a Women in STEM workshop, held alongside APEC's Women in Economy Forum, provided insights from a range of leaders in the field, including educators, community organizers, and private-sector leaders from STEM communities. In October 2016, the framework was formally discussed at a forum held alongside of the meetings of APEC's Education Ministerial, which offered a final "vetting" of the proposed framework and recommendations with a dynamic and cross-cutting set of stakeholders.[1]

[1] This study is also informed by APEC's significant efforts to build greater understanding, and to seek solutions, pertaining to women's economic opportunity and empowerment across APEC. This ongoing work includes not only the Dashboard, but also the

Through this report, information and insights derived from the Women in STEM study are organized across the final framework. Each section includes a set of potential interventions that draws from the range of experiences and suggestions collected during this study. This report culminates in a set of recommendations for strengthening APEC-wide conditions for women in STEM. The overall goal of the initiative is to help APEC economies and companies meet their demands for skilled labor that can support dynamic and innovative STEM sectors. Equally important, this initiative will help increase women's presence and influence in STEM throughout APEC, so that, along with their families, women can realize the benefits of careers that offer higher pay and greater opportunities than those they have traditionally dominated.

From the APEC Women in STEM Survey: What are your economy's priorities with respect to encouraging women's participation in the STEM fields?
• "To address the cultural and organizational factors that discourage women from studying STEM and from pursuing careers in the STEM industries." • "To eradicate gender stereotypes in vocational training of boys and girls." • "To encourage the participation of women in fields such as ICT." • "To raise interest in the sciences among female junior high school and high school students, by providing role models and career paths for female academics and engineers." • "To encourage and enable better engagement with science and technology across all sectors of society." • "[To provide] equal access to STEM education and career opportunities through implementation of specific policies that are reflected in programs and policies, such as STEM scholarships and capacity-building programs."

A REMINDER: WHAT DO WE MEAN BY STEM?

The STEM disciplines are interrelated and interdependent, and many areas of study and career paths incorporate more than one. In general, though, each component has discrete features and offers unique opportunities. The needs and working environments of a patent examiner, for example, are quite different from that of a petroleum engineer, a laboratory technician, a land surveyor, a physician, or an accountant. At the same time, STEM professions afford relatively stable and in-demand jobs at all levels of education – from technical support positions that may be accessed with a vocational or secondary-school degree, to work that calls for education at the bachelor of sciences, master's, or Ph.D. levels.

Science is the study of laws, derived through observation and experimentation, which govern nature and the physical world. Disciplines in science are generally classified based on the portion of the universe studied: space (i.e., astronomy), earth (i.e., geoscience), life (i.e., functional and cellular biology), social (i.e., psychology), and physical (i.e., physics and chemistry). Science is at the foundation of medicine and health care, an area that implicates a range of STEM-related professions. There is a vast array of jobs for scientists, including in industry, agriculture, services, and trade. According to UNESCO data, although the representation of women studying science in APEC's member economies has expanded significantly, women

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Women Entrepreneurs in APEC (WE-APEC) initiative, the APEC Women in Transportation (WiT) initiative, and the APEC Healthy Women, Healthy Economies initiative. It also encompasses key takeaways from the assessments of individual economy environments for women's economic empowerment in Papua New Guinea (2013), Chile (2013), and Peru (2016).

still account for a minority (less than 30%) who pursue careers in scientific research. (UNESCO Institute for Statistics, Science, Technology, and Innovation).

Technology is a body of knowledge devoted to creating tools, processing actions, and extracting of materials. (Ramey, 2013). Helping people accomplish tasks in their daily lives, technology takes the form of products, processes and systems. Technology spans a range of areas where people have sought to invent processes or make them better, including in health and mobility, communications, music and the arts, construction, business, and more. Historically, technology included innovations such as machines and engines, appliances, and even tools that support science itself – microscopes, telescopes, submarines, lifesaving medical equipment, and many, many other advances. Today, a great deal of emphasis is placed on information and communications technology (ICT), including innovations, changes, or modifications pertaining to computer hardware, software, systems and networks. (U.S. Bureau of Labor Statistics, 2015). With the turn of the millennium, ICT has achieved an exponentially transformative and omnipresent effect on way the individuals, societies and economies connect, communicate and conduct transactions. The range of technology jobs spans disciplines related to operating systems, programming, and artificial intelligence. Tech workers may be designers, inventors, computer scientists, network systems analysts, programmers, software engineers, database administrators, and more.

As a field, technology remains especially dominated by men. The percentage of women entering computer science and ICT in the United States actually dropped by nearly 30 percent between 2001 and 2011. (Lockheed Martin, 2016). Technology jobs in certain instances can be accessed through a relatively condensed period of education, including coursework focusing on coding and other foundational skills that may allow for growth on the job, once a worker has joined the field.

Engineering entails the use of mathematical and natural sciences to solve "real-word problems." The engineering field requires developing systems, structures, products or materials for the benefit of society. Disciplines include civil, mechanical, industrial, electrical, and materials engineering. They are categorized by industry such as aerospace, petroleum, medical, and textile. Engineering takes place in a variety of sectors, the largest being business, government, and education. UNESCO data show that women graduate from engineering programs at rates far less than men, with Malaysia and Brunei Darussalam the exceptions within APEC. Gender stereotypes and expectations begin especially early in engineering: even today, parents tend to encourage boys to play at building and construction, while girls are steered toward more traditional, "feminine" toys and games (OECD, The ABC of Gender Equality, 2015). The engineering field relates closely to another APEC initiative, Women in Transportation, through which several APEC economies are working to strengthen the presence of women in the aerospace, maritime, road transport and rail fields. (APEC Transportation Working Group, 2015).

STEM + Art & Design = STEAM

In the 21st century, various practitioners have added "Arts & Design" to the discussion of science, technology, engineering and math. The notion of "STEAM" captures the inherent and essential role that artistic inquiry and sensitivity to design plays in driving awareness, creativity and innovation. Arts & Design involves the practice of absorbing information and producing ideas that contribute to the vision, function and communication of product and language in the everyday world. Whether by building a bridge or creating an app, the ability to meld artistry with function is a highly valued skill.

Mathematics is a language of numbers, operations, patterns, and relationships. Math uses "numerical, spatial and logical relationships to study and solve data problems, deduce patterns, test relationships and to develop models that are conducive to real world use." (U.S. Bureau of Labor Statistics, 2015). Math is the field at the foundation of science, technology and engineering. Careers in mathematics span

the disciplines of algebra, statistics, calculus, game theory and geometry and intersect heavily with the fields of engineering and science. Given the far-reaching prospects of math education, mathematicians can work with such entities as engineering companies, computer firms, government contractors, offices and agencies, consulting firms, aerospace and transportation equipment manufacturers, medical companies, and academic and research institutions. Strong math skills also afford workers the opportunities to assume high-level work in finance, accounting, and economics.

WHY IS WOMEN IN STEM A PRIORITY?

There is demand across APEC for more women in STEM for two primary reasons. First, the STEM fields are themselves critical to economic growth. Yet most fall far short of fully incorporating the talents offered by women. Without meaningful participation of women, STEM innovations – such as medical research, product development, and advances in engineering – are unlikely to reach their full potential, because they lack the insights and experience that women bring to the challenge.

Second, opportunities in STEM provide to women, in many instances, better livelihoods than the lower-wage fields that they currently dominate. The relatively stronger incomes, benefits, and opportunities afforded by jobs that require STEM-related skills can bolster the economic progress of women and their families. And in turn, entire economies will progress.

STEM is the foundation of innovation and growth. As articulated by APEC's Policy Partnership on Science, Technology, and Innovation, innovation is critical to improving the quality of growth, promoting economic and social development, addressing shared challenges, and achieving prosperity in the Asia-Pacific region and beyond. (APEC PPSTI, Strategic Plan, 2016-2025). And, as a driver of innovation worldwide, a thriving STEM workforce is an economic imperative:

> A critical driver of any economy is its ability to foster innovation – the process of transforming ideas into new and improved systems, services, or products that enhance the value of existing resources or the creation of new ones. One of the primary ingredients of successful innovation is an education system that embraces the development of the next generation of innovators and promotes a culture of Innovation Excellence … Strengthening the presence of innovation in education and workforce development initiatives represents a critical method to stimulate economic and social growth. (Kleinbach-Sauter and Montoya, 2014).

Opportunities in innovation are only as abundant as the workforce that can identify and cultivate them. Where half of the population is significantly underrepresented in the STEM fields found at the heart of innovation, then innovation itself suffers. Gender diversity within the qualified workforce is increasingly understood as a strategic advantage: women as STEM workers may be better able to anticipate and respond to the needs of consumers – including women all over the world with purchasing authority within their own households – even more than their male counterparts. The business case for greater inclusion of women, along with the correlation between women's economic participation and the health of economies, is becoming increasingly familiar to policymakers and private-sector leaders. (McKinsey & Company, 2012).

Moreover, it is widely asserted that more women in STEM makes for *better science*. Governments and firms investing in research and development that may lead to scientific advancement increasingly understand that greater inclusion of women improves the process of scientific inquiry. For a diverse science and engineering ecosystem, many public research agencies within APEC seek more women among

> *Finding solutions to many of the big problems of this century, including climate change, universal access to water, disease, and renewable energy, will require the skills of engineers and computer scientists. When women are not well represented in these fields, everyone misses out on the novel solutions that diverse participation brings.*
>
> American Association of University Women (2015).

both their grant applicants and panelists who review the applications. This broadening of perspectives – incorporating all kinds of women, including those representing minority, urban, rural, differently abled, and other discrete communities -- promises to result in a more diverse set of inquiries and discoveries. Many firms have learned the hard way that it is not enough to test potential scientific or technological breakthroughs on men – if they do not think to include all kinds of women, they can miss critical and even life-saving insights. (Lockheed Martin, 2016).

STEM jobs contribute to women's economic empowerment. Fundamentally, offering women and girls the tools of economic empowerment that are more generally held by men – including the confidence, qualifications, and ability to participate in fields where the pay is good and the demand for skilled labor is high – is a critical aspect of gender equality. In contrast to many workers who lack STEM competencies, women entering the workforce with a firm STEM foundation often experience their pick of employers. They typically qualify for the more lucrative jobs in fields with the highest demands for labor, such as health and environmental sciences; electrical, mechanical and civil engineering; information sciences and systems; economics and finance; and architecture and design. (U.S. Department of Commerce, 2011).

Proficiency in STEM disciplines increases a women's value as an employee even in non-STEM fields. As technology becomes integrated throughout all corners of the economy – including manufacturing, agriculture, transportation, professional and educational services, retail and wholesale trades, tourism, and even the arts – the ability of a woman to rise to STEM-related workforce demands can make all the difference in terms of her employability.

As detailed in this report, improvements are needed not only for women to qualify for STEM jobs, but also for them to be able or willing to stay in those fields. Ultimately, women should not have to endure unfair stereotypes about their qualifications, unequal pay, hostile work environments, or conditions of work so inflexible that it is impossible to balance work with parenthood. With improved conditions for women in STEM, women's lives, and the lives of their families and communities, can change for the better. Through job opportunities associated with STEM, women tend to be more empowered, have greater influence, and receive more respect in their households and society at large. (USAID/US-ATAARI Women in the Economy Dashboard Introduction and Analysis, 2014). And, when women are economically empowered, they typically invest a higher proportion of their earnings in their families and communities than men. As summarized by the OECD, "Women's economic participation and their ownership and control of productive assets speeds up development, helps overcome poverty, reduces inequalities and improves children's nutrition, health, and school attendance." (OECD, 2010).

WANTED (AGAIN): MORE AND BETTER DATA

APEC's Women and the Economy Dashboard, established in 2014, covers the five priorities enunciated by PPWE since its establishment in 2011: (a) Access to Capital and Assets; (b) Access to Markets; (c) Skills, Capacity-Building, and Health; (d) Leadership, Voice, and Agency; and (e) Innovation and Technology. Under each of these priorities, the Dashboard sets forth up to six "contributing factors" influencing the experiences of women, each measured through a set of indicators maintained chiefly through credible, reliably updated international sources. Among the contributing factors, a number directly or indirectly pertain to Women in STEM, including measures of educational achievement; opportunities for employment and advancement; and

access to the internet and mobile technology. Progress in each promises to strengthen conditions generally for women's economic participation, including women in the STEM fields.

In September 2015, the Policy Support Unit of the APEC Secretariat reported on the more than 75 Dashboard indicators for the first time. Among the contributing factors listed under the Dashboard's Innovation and Technology section is Women in STEM. As with several of the Dashboard's contributing factors, finding a metric available across most of APEC's 21 economies proved difficult. Ultimately, the only regularly maintained, publically accessible source that provides reliable data for several APEC economies is UNESCO's Institute of Statistics. Relying on UNESCO's data, the Women in STEM contributing factor, as compiled by the PSU, consists of four indicators:

1. Percentage of female graduates from tertiary education graduating from Science programs among all science graduates.
2. Percentage of female graduates from tertiary education graduating from Engineering, Manufacturing and Construction among all Engineering, Manufacturing and Construction tertiary-education graduates.
3. Percentage of women researchers – specifically, the percentage of female professionals in relation to the total number of professionals engaged in the creation of new knowledge, products, processes, methods and systems, as well as in the management of these projects, based on headcount. Headcount includes staff employed both on a full-time and part-time basis.
4. Percentage of women R&D personnel – that is, the percentage of women employed directly in R&D jobs as well as those providing direct services such as R&D managers, administrators and clerical staff based on headcount. Again, headcount includes both full-time and part-time staff.

When compiling the benchmarking data for the Dashboard in September 2015, the PSU found that there is not yet enough UNESCO data available to create an aggregate figure for APEC in any of the Women in STEM indicators.[2] Thus, APEC Women in STEM begins its inquiry with critical information gaps: As of 2016, using consistently defined, maintained and internationally compiled data, the percentage of women among APEC's university graduates in science and engineering is not certain. Even for the straightforward question of women's representation among Science and Engineering, Manufacturing, or Construction graduates, UNESCO reports on fewer than half of the APEC economies. And still less data is compiled concerning women in APEC's scientific R&D jobs.

Beyond the UNESCO indicators tracked by the Dashboard, there are many more areas of direct or related interest to Women in STEM for which APEC, as a region, cannot produce consistently defined and maintained sex-disaggregated data. These include the following:

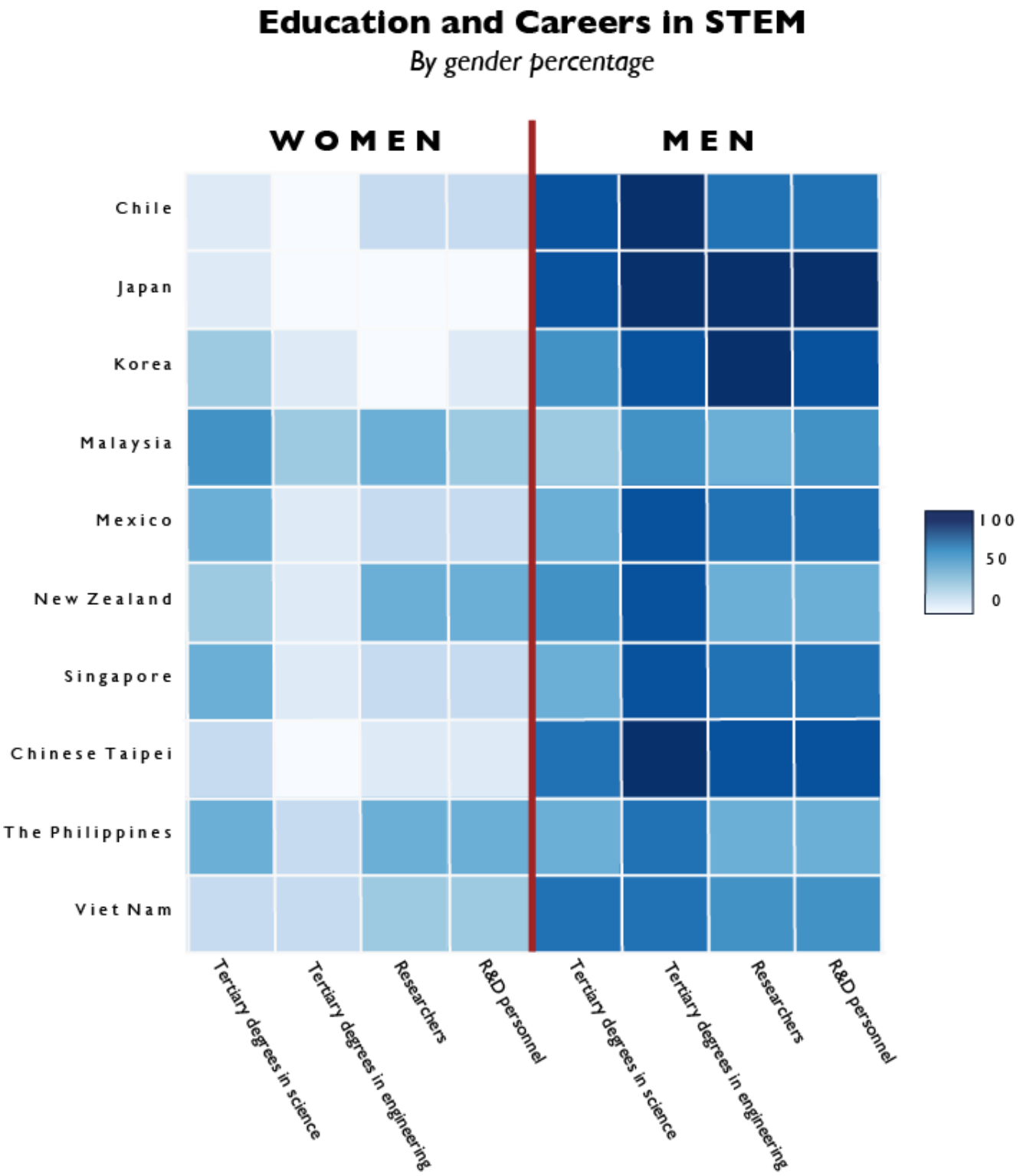
- Presence of women faculty in university STEM programs
- Share of workers in STEM jobs by gender and educational attainment, disaggregated by STEM sub-sector
- Extent to which women university graduates with STEM degrees remain in STEM occupations
- Average earnings between men and women holding STEM jobs, and gender wage gaps between university-educated STEM workers
- Rates at which women seek and receive patents for their inventions

[2] For the Women in STEM indicators, the PSU relied on UNESCO data for most economies, while also integrating data maintained by domestic sources in Chinese Taipei and Singapore.

- Presence of women in managerial positions among STEM employers
- Rates at which women as STEM entrepreneurs receive funding or capital, as compared to men.

Among this report's recommendations geared toward APEC at large is the charge to continue promoting among economies the importance of sex-disaggregated data within all social and economic functions, including in the STEM fields. APEC economies can support this effort through conscientious monitoring and reporting of data as consistently defined and synthesized by international organizations, including UNESCO.

Figure 3


Education and Careers in STEM
By gender percentage
WOMEN
MEN
Chile
Japan
Korea
Malaysia
Mexico
New Zealand
Singapore
Chinese Taipei
The Philippines
Viet Nam
100
50
0
Tertiary degrees in science
Tertiary degrees in engineering
Researchers
R&D personnel
Tertiary degrees in science
Tertiary degrees in engineering
Researchers
R&D personnel

An emerging array of sources on women's progress in STEM

Most economies – whether through government, the private sector, academia, NGOs, or other sources – harbor a range of studies, reports, and statistics that, directly or indirectly, illuminate domestic conditions for women in STEM. Much of this research is disaggregated by STEM topic – such as the presence of women in engineering in a single economy (IPENZ, 2015), or conditions for high school girls studying math (Hill/AAUW, 2015). While these sources are useful for the purpose of "drilling down" into discrete issues, data in the STEM arena generally are neither consistently defined nor maintained across all or most APEC economies. Moreover, workforce statistics about women in STEM are widely shielded from public review and discussion when they are maintained by private sources, such as by companies that prefer not to disclose their internal information. (Some large multinational firms, such as Google, Intel, and Microsoft, have committed to sharing key numbers and targets with respect to their internal diversity, thus setting a standard for the ICT industry).

The International Labor Organization maintains generalized data pertaining to work in STEM-related sectors, but consistent sex-disaggregated job statistics across economies remains elusive. Indeed, with the United Nations' adoption in 2015 of the 17 Sustainable Development Goals to end poverty, protect the planet, and ensure prosperity through 2030, the dearth of sex-disaggregated data generally – along with traditions of gender bias in the collection of data – has received increased international attention. For example, in 2016, the Bill & Melinda Gates Foundation committed $80 million toward closing data gender gaps for the purpose of accelerating progress for women and girls. (Bill & Melinda Gates Foundation, 2016).

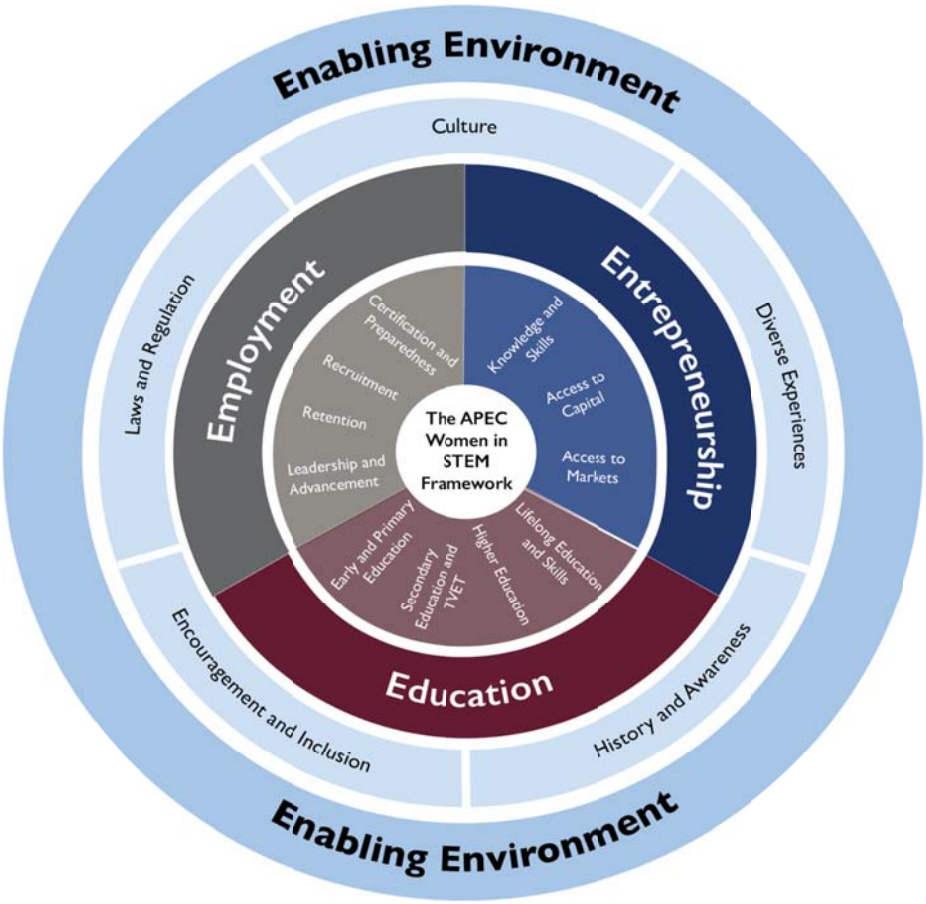
Increasingly, some organizations contribute to the supply of data pertaining to girls and women in STEM on a regional or worldwide basis. For example, every three years, the OECD's PISA test tracks scores of boys and girls in 70 economies, including 18 from APEC, with results providing important comparative insights on the relative achievement in math, reading, and science. In 2015, UNESCO announced its STEM and Gender Advancement (SAGA) initiative, which aims to address the worldwide lack of data in the future. Broadening its supply of indicators and methods to measure and assess sex-disaggregated data on women's participation and the barriers they face, SAGA's goal is the reduction of the gender gap in education and scientific research. (Gates Foundation, 2016).

Also in 2015, the Association of Academies and Societies of Sciences in Asia (AASSA) published a report entitled *Women in Science and Technology in Asia*, detailing the results of a survey and analysis of its 32 members – though it was able to collect data from only ten (Australia, Bangladesh, India, Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, and Turkey), just four of which belong to APEC. The AASSA study referenced a variety of statistics maintained in individual economies, including the presence of women on university science faculties, in agricultural research institutes, and in various government science and technology jobs. Many of the findings of that report are integrated into findings and potential innovations included in this report.

THE APEC WOMEN IN STEM FRAMEWORK

APEC is addressing Women in STEM at a time when a wealth of policies, initiatives, and practices across the region, both public and private, have begun to strengthen the pipeline of girls and young women into STEM fields and improve conditions so that they elect to stay. For the purpose of sharing strategies and learning from one another, the Women in STEM framework organizes the main topics that arose during US-ATAARI's research and discussions since the launch of this initiative in February 2016. First shared at the Women in STEM workshop held alongside APEC's Women in the Economy Forum (WEF) in June 2016, the framework was further refined during a "vetting" process that took place at the Women in STEM forum held alongside the Education Ministerial meetings in October 2016.

This section sets out each pillar and sub-pillar of the framework, discussing them in the context of key statistics and/or economy-specific examples. Then, for each section, it summarizes potential interventions. The interventions reflect innovative and forward looking activities already taking place across APEC governments, academic institutions, companies, and not-for-profit organizations which could be expanded and/or replicated. They are synthesized from variety of sources, including interviews, conferences and workshops, formal reports, and desk research. Although there is a dearth of information about the precise impacts of these potential interventions (with certain exceptions), each appeared several times during the course of the study, so indeed are viewed by many as "promising practices."



ENABLING ENVIRONMENT

The first "pillar" of the framework, enabling environment, in fact encompasses the three other pillars – education, employment, and entrepreneurship – because it entails a range of factors that spans women's lives. Enabling environments begin with culture – that is, the values, patterns of behavior, and interactions that prevail in an economy, drawn from customs, conditions, and general socialization. Culture often dictates how women and girls are treated and perceived, and it can strongly influence the paths they follow.

Next, laws and regulations represent society's priorities and government's policies, and in many instances dictate the role of women in society. From there, enabling environments implicate history, awareness, encouragement, and inclusion – that is, a series of conditions that shape society's views of whether women belong in STEM fields generally, and whether, personally, a girl or women feels comfortable taking on the challenges STEM presents. Finally, in any given economy, women rarely represent a single set of interests or conditions. Enabling environments encompass a diversity of experiences according to a woman's race, class, religion, ethnicity, physical ability, or even origins in rural, suburban, or urban surroundings.

Culture

Inclusion of "culture" as a sub-pillar within the Women in STEM framework is a direct outcome of the October 2016 APEC Women in STEM forum. Participants at the forum agreed that, even before capturing an economy's legal framework and specific history and awareness of Women in STEM, enabling environments reflect fundamental attitudes and views about the roles, rights, capacities, and potential of girls and women. The extent to which culture impacts the personal growth and decision-making of girls, along with the critical role that family plays in shaping the goals and self-perceptions of girls, is also part of the enabling environment. Specific issues such as the place of women in the home, and whether they experience domestic violence, bear the overwhelming share of family care, or have a say in how they spend their earnings, relate to the culture that influences the life-paths of women. (Of course, culture also impacts boys and men, who may, for their part, feel discouraged from pursuing interests or fields that do not fit with traditional views of masculinity).

> *"From early childhood, we are exposed to stereotypes that guide our choices and behavior and often invisible ways, steering us toward certain careers and away from others."*
>
> American Association of University Women, *Solving the Equation: The Variables for Women's Success in Engineering and Computing* (2015)

Culture is typically reinforced through stereotypes that begin at home. During an early consultation of around twenty STEM industry representatives for this study, participants discussed how the most significant influence on whether girls pursue STEM can be parent support and encouragement. (Notes from APEC Women and STEM Consultation, 2016). In many economies, for example, sons are prioritized as potential earners, while daughters are seen as "taking the load off" working parents, as well as providing care for aging parents. (Ibid).

Negative stereotypes persist in communities, schools, and workplaces, through both deliberate and unconscious bias. Mass media, including television, film, and the ever-expanding world of digital content, contribute to and reinforce these stereotypes. On the one hand, media can, through sexist stereotypes or exclusion of women entirely, undermine women's participation in STEM. On the other, media has, though positive role-modeling and inclusive use of images and language, the power to change expectations and attitudes. A 2013 analysis of how media can shape the stereotypes that influence whether girls and women participate in STEM included the following observations:

- The behaviour of individuals is grounded on their observation and imitation of other individuals, including fictional characters appearing in mass media.
- If most of the images of women that young girls see fall into a limited number of categories, girls will harbour limited beliefs about who they can become.
- Pervasive negative stereotypes about women and science and math constitute some of the most important and insidious roadblocks to attracting and retaining women in STEM fields.
- Societal stereotypes impact the way women and girls are treated in the workplace and in school, decreasing their enjoyment and value when actually participating in STEM fields and impeding the development of related skills. (Brahatt, et al, 2013).

Of course, assumptions about culture – and the extent to which culture defines what women study and whether they are economically active as adults -- may defy expectation. For example, despite relatively high rates of labor force participation among women ages 18-64, women from Australia (at 70.7%) and the United States (66.2%) are among the *least* likely among APEC economies to study engineering – fewer than one in four engineering students in Australia and the U.S. are women. Conversely, the highest representation of women in APEC studying engineering – at one in three or more – is found in those APEC economies where the labor force participation of women among the lowest – Malaysia (47.2% labor force participation rate), Mexico (48.3%) and Brunei Darussalam (55.5%). (World Bank Gender Portal, 2014; UNESCO Institute for Statistics, Science, Technology, and Innovation). Thus, it may be that some of the strongest candidates for STEM jobs may remain economically inactive.

Through consultations with experts and review of current literature, this study identified a number of ways culture may be approached to improve the chances that girls and women will both persist in STEM-related studies and thrive in careers in STEM fields:

For economies, educators, employers, the media, and other institutions:

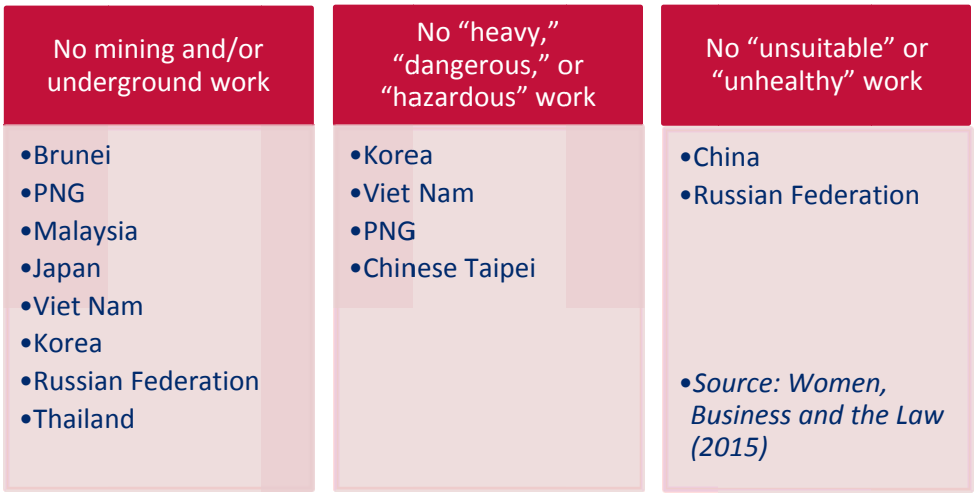
- Encourage political and private-sector leaders, along with domestic and regional celebrities and other thought leaders (such as tribal or religious leaders), to invest personal capital and serve as role models for mind-sets and behaviours that value women and girls and accept their full participation in society.
- Create awareness about the harms of stereotypes, within individual schools, firms, and professional organizations, and within society at large. Teach decision-makers, managers, teachers and trainers about stereotypes and implicit or unconscious bias that may discourage or intimidate girls and women from participating in STEM, including harassment, isolation, and lack of mentorship or feedback.
- Pay special care during students' early years to avoid perpetuating stereotypes that may lead any child to believe that girls do not "belong" in STEM. Review texts, graphic representations, games, media, and other classroom and extracurricular materials that may inadvertently reinforce these stereotypes.
- Support development and dissemination of media content that casts both men and women from all backgrounds in a variety of roles, including roles in the home and the workplace that defy common expectations and stereotypes.

Laws and Regulations

As women become increasingly educated and qualified to hold positions previously dominated by men, they may still find that the legal environment – however subtly – closes many doors. A host of laws and regulations across APEC contribute to women's inability to participate fully as workers in "non-traditional" fields – that is, those that may require rigorous outdoor or underground work, heavy lifting, or work at all hours of the day – which disproportionately impacts women as engineers, geologists, energy professionals, researchers, and

so forth (Figure 2). Moreover, certain well-intended laws drive up the cost of employing women as compared to men, such as requirements that employers provide child care services for working mothers (but not fathers), or lengthy terms of maternity leave (without similar terms of paternity leave). (USAID/US-ATAARI, Dashboard Introduction and Analysis, 2014). Fewer than half of APEC's economies provide for parental leave on an equal basis between men and women, and just seven require employers to return women on maternity leave to a job equivalent to the one they had. (Zhu, 2015). Five APEC economies have statutory ages of retirement that are younger for women than for men. (Zhu, 2015).

Figure 2: In half of the APEC economies, the law restricts women from certain jobs



Another area of law that has significant bearing on women in STEM is that of sexual harassment. As documented by the World Bank's Women, Business and the Law project, legal protections against sexual harassment vary among APEC's 21 economies. Sixteen of APEC's economies have one or more laws that specifically address and protect against sexual harassment in employment, including unwelcome sexual advances; requests for sexual favors; verbal, physical conduct, or gestures of a sexual nature; harassment with sexual content; or any other behavior of a sexual nature that might reasonably be expected or be perceived to cause offense or humiliation to another. Just eight economies, however, have laws specifically forbidding sexual harassment in education, including within educational facilities, schools or where the offender is in the role of educator, professor, or in charge of the education of the victim. Even in places where sexual harassment laws or policies are in place, they are often not adequately enforced. (Women, Business and the Law, 2016).

Insufficient attention to sexual harassment generally may be particularly harmful to women studying and working in STEM fields, where they are often in the minority. For example, one study of workers conducting scientific fieldwork found women trainees in the social, life, and earth science disciplines to be particularly vulnerable to sexual harassment and even assault by individuals who are senior to them on their research teams. More than 80 percent of 180 trainees surveyed reported sexual harassment in their field work. (Clancy, 2014). Similarly, a survey of more than 200 women working in Silicon Valley – a hub of technology jobs – found that 60 percent of respondents with at least 10 years work experience had experienced workplace sexual harassment. (Vassallo, 2015).

On the other hand, equality in law is a powerful means of opening doors for women in STEM. A prominent example of this is Title IX of the Education Amendments in the United States. Since 1972, Title IX has prohibited educational programs that receive federal funding from discriminating on the basis of sex. Beyond its well-known application to women's sports, Title IX requires educational institutions receiving federal support to ensure equity in STEM education for all students. This includes adopting policies and procedures that prevent and correct sex discrimination. The U.S. Department of Education provides a number of resources in this regard,

including communications and training materials that help administrators and teachers understand their obligations and put them into action. (U.S. Department of Education, 2016). In addition, Title IX requires educational institutions receiving federal grants, including scientific research grants, to provide equal opportunities for women and girls in STEM education, including equal consideration in promotion and tenure for faculty.

Over more than 40 years, the impact of Title IX has been far and wide, and includes far greater inclusion of women in higher education; a much broader set of career options introduced to both sexes; legal protection for pregnant and parenting students; improved access of women to academic positions, and more. (Chadband, 2012). In STEM fields, women and girls have made significant advancements toward parity—for example, medicine and pharmacology are increasingly gender-balanced. Significant gaps remain, however, particularly in engineering and computer science. (*Title IX at 40*, 2012).

Most potential interventions in the realm of laws and regulations do not specifically address the STEM professions. Rather, they represent good economy-wide practice in gender equality generally, and include the following:

For economies:

- Conduct an analysis of domestic labor and employment laws and laws pertaining to education, to ensure that they directly support gender equality and do not directly or indirectly perpetuate practices or stereotypes that discourage girls and women from participating in STEM.
- Bring laws and regulations pertaining to equal opportunity in employment and education, equal pay, anti-harassment, and parental leave into line with gender-equitable best practices, such as those described in the World Bank's *Women, Business and the Law* initiative.
- Develop public policy agendas that call for the public and private sectors to actively encourage women's participation in STEM fields. Assist educational institutions and employers in understanding and implementing their legal obligations.

For educators and employers:

- Ensure compliance with existing law, including labor and employment laws, equal opportunity law, education laws, and other key sources of authority over how schools address gender and employers treat women as workers.
- Maintain regular and verifiable sex-disaggregated statistics on enrolment and graduation (educational institutions) and recruitment, hiring, retention, promotion, and leadership (employers).
- Move beyond legal compliance and take on proactive and creative approaches to attain the spirit, and not just the letter, of equal opportunity law, including through various interventions listed in this report.
- Institute and enforce policies that create welcoming education and work environments for women and girls, including anti-sexual harassment policies.

History and Awareness

Whether the historical contributions of women to science and innovation are known and celebrated can make the difference in whether girls can even picture themselves in STEM-related careers. The contributions of men, of course, are taken for granted in textbooks and public discourse. Until recent generations, the very presence of women was curtailed by cultural expectations and exclusion from formal education and leadership opportunities. Among women who did break through, their contributions and achievements typically failed to

gain professional recognition or a place in the history books, even as their male colleagues received credit. Although textbooks, teaching materials, and popular culture in some economies have begun to reflect the extensive and historic scientific contributions of women, public awareness of women as critical partners in scientific inquiry remains low, even among STEM professionals.

As economies recognize the urgency of addressing the dearth of women in STEM, they have become creative with interventions that call attention to the history of women in the field as a means of building better public awareness. All over the world, school districts have amended textbooks and curricula to ensure that that contribution of women scientists are noted and explained. In 2014, the United States created an online set of oral histories from STEM leaders in government, who talk about "amazing STEM heroes who should be household names" but who, as women, were significantly overlooked by the history books. Similarly, Australia's Science 50:50 Program has developed a video series aimed at capturing the interest and imaginations of girls, including a section on "Inspiring Women in STEM." In July 2016, the Society for Taiwan Women in Technology (TWIST) welcomed the publication of a book containing the stories of the achievements of 37 women scientists from Chinese Taipei. And, in January 2017, 20th Century Fox will release *Hidden Figures*, a film about three African-American women who supplied critical mathematical data needed to launch NASA's first successful space missions.

Honoring a Great Woman in Science: The Alice Wilson Award (Canada)

"The Alice Wilson Award was established by the [Royal Society of Canada in 1991 … to honour the memory of Alice Evelyn Wilson (1881-1964) … a world-renowned paleontologist and one of Canada's foremost geologists. Her career with the Geological Survey of Canada lasted from1909 to 1946, while she advanced from museum assistant to geologist. In addition to her research contributions, she brought geology to the public, especially to children, in many ways. The award is given yearly to three women of outstanding academic qualifications in the Arts and Humanities, Social Sciences or Science who are entering a career in in scholarship or research at the postdoctoral level."

Source: Website of the Royal Society of Canada

The Canadian scholarship program that honors Alice Evelyn Williams (see box) is another example of how a woman's contribution to science can be revived in an economy's awareness of its own history. It is notable that, though named for a scientist, scholars in a number of fields are eligible for consideration, thus spreading the name of this important Canadian into the consciousness of people throughout society.

Potential interventions in the area of history and awareness include the following:

For economies, educators, and employers:

- Review curricula shared in the early stages of education to make sure that the contributions of women scientists and innovators – as individuals and team members – are noted as relevant and valuable.
- Through public-private initiatives, including traditional and new media, celebrate and increase the availability of information about women in history, stressing in particular their contributions to the STEM fields. Develop products and programs that cast women in positive roles as scientists, researchers, engineers, and non-traditional technical support jobs.
- Inspire girls from an early age: Work as a community to demonstrate that they can participate in any field, including those where women are not traditionally engaged. Encourage parents and families to reinforce this message through STEM-related community activities, including scouts, after-school activities, and opportunities to visit and observe women who work in STEM fields.

- Call attention to the achievements of Women in STEM (and the imperatives of scientific inquiry) through awards and scholarship programs. Encourage women to participate in international or regional programs, such as the Association for Southeast Asian Nations (ASEAN)-US Science Prize for Women, first launched in 2016 as a $25,000 reward for research in sustainable energy.

Encouragement and Inclusion

Beyond legal empowerment and general societal awareness, women and girls need to be proactively included in STEM learning and career paths. Even more, they need encouragement to stay in the field when they feel alone, unappreciated, over-burdened by family obligations, or unwanted. This can be achieved both through public policy interventions and individual institutional efforts – including by schools and universities, professional and social organizations, the private sector, and the media – to foster a culture of encouragement and inclusion. The purpose of such deliberate efforts is to counter the overt and subtle sources of discouragement that persist across APEC's economies.

As one example, in 2015, the Institute of Professional Engineers New Zealand (IPENZ) took a "snapshot" of women in that economy's engineering workforce. (IPENZ 2015). IPENZ surveyed 15 organizations that employ over 19,600 people in New Zealand. The survey found around one-third of this group to be female, of whom 4,378 were engineers. Around 16 percent of the engineers in the entire group were women. And, although the 15 employers surveyed reported that they increased the rate at which they hire women – to around 25 percent in 2014 – the analysis found that, over time, the representation of women diminishes. In 2015, just nine percent of the surveyed organizations' technical leadership, management, and governance roles were held by women.

Drawing from this snapshot, IPENZ launched an economy-wide conversation concerning how to encourage greater participation of women in engineering. IPENZ's proposed agenda for action illustrates the breadth of variables at play. Namely, do schools and employers "market" engineering properly to girls and young women? Are parents and teachers – so crucial to setting a path for students in math and science – themselves aware of the opportunities available to women in engineering? What can engineering organizations do to increase retention of female engineers, and how can employers increase workplace flexibility without diminishing professional opportunities afforded women? By starting with data, and then challenging the whole ecosystem of engineering to consider changes it may need to make to address its findings, IPENZ has set a course for encouragement and inclusion.

The APEC Women in STEM survey uncovered a number of additional examples of how economies are working to support girls and women in overcoming long-entrenched social expectations or cultural norms. Among them:

- In Japan, the 4th Science and Technology Basic Plan, put into place by the Cabinet Office and Ministry of Education, Culture, Sports, Science and Technology in August 2011, and reaffirmed by subsequent measures, sets a goal to increase the percentage of female researchers in the natural sciences field to 30 percent.
- Papua New Guinea's National Public Service Gender Equity and Social Inclusion (GEDI) initiative provides guidance to public agencies in gender equity and social inclusion issues within their own workplaces. The policy provides the framework for change by ensuring that relevant values and principles are adopted into long and short-term strategic planning.
- In Australia, Male Champions of Change is a coalition of male leaders who advocate for gender equality within companies, organizations and communities. Launched by the economy's Sex Discrimination Commission, MCC establishes four categories of action for men: (1) stepping up as leaders; (2) creating accountability; (3) disrupting the status quo; and (4) dismantling barriers for caregivers. Concrete actions include the active cultivation and selection of women as leaders in

the top management team; the "Plus One" initiative, which encourages senior managers to have at least one female manager on their team as openings arise; the "Supplier Multiplier" commitment, which encourages male CEOs to diversity their supplier base; and the creation of flexible workplaces.

Additional examples of how girls and women can be encouraged to grow and advance in STEM are set forth later in this report. From a broader perspective, potential "encouragement and inclusion" interventions include the following:

For economies, educators, and employers:

- Research the representation of women in specific subsectors of STEM, analysing data for trends and opportunities. Compare those subsectors of STEM where the participation of women has strengthened in recent years – such as medicine, pharmacology, and marine science – with those – such as most forms of engineering – where women remain underrepresented. Seek to apply the positive experiences of one to the other.
- Conduct an economy-wide dialogue on girls and women in STEM, bringing people from various institutions and sectors to share best practices and to coordinate or scale outreach and inclusion efforts. Access various types of media, including social media, to share the outcomes of this dialogue, and to sustain public conversation on the issues.
- Encourage networking among women who work in the various STEM fields, including for the following purposes: Information-sharing; mentoring, coaching, training, or financial aid opportunities; taking on projects that individuals might not be able to manage themselves; identifying new opportunities for advancement; advocating on behalf of shared interests.
- Champion accomplishments of girls and women in STEM, including through government-sponsored showcases and private media events. Connect institutions seeking information about these activities with schools and organizations that have made them happen.

Diversity of Experience

Another direct outcome of the October 2016 APEC Women in STEM forum is the unequivocal recognition that, while women as a group face a range of challenges with respect to their full inclusion in STEM, experiences among women across APEC economies differ greatly. As summarized by one forum participant, "We can't think of girls and women as a single group. Gender is not the only aspect of diversity."

Indeed, in North America, women of African heritage are vastly underrepresented in nearly all STEM fields, including as PhD scientists and across the range of STEM jobs. Among the consequences of this deficit is that girls of African heritage lack role models in STEM. "With few people who look like them actively working in the field, young black girls are often discouraged from pursuing hard sciences that might otherwise interest them," according to one article on the topic. (Levine, 2015). Moreover, in the North American STEM workplace, all women of color are burdened many times over:

> [There are] multifaceted challenges that limit progress, which can be broadly classified as the following: workplace climate issues; unique social challenges, health disparities and family responsibilities; high community service demands, insufficient social support and ongoing discrimination; and limited access to mentoring and social support networks. (Thomas, et al., 2014).

Within academia and the workplace, women from minority groups further experience marginalization and small inequities that can undermine their sense of belonging and, eventually, their desire to stay in the field. Through the overt or unconscious bias of their colleagues, their work may be undercut or dismissed and they

may find themselves excluded from mentoring relationships or social interactions that help them move forward.

Diversity of experiences among women exists in all economies. The differences in the way women are treated may arise from their racial or ethnic identities, as well as from distinctions in social class, religion, rural vs. urban backgrounds, or physical abilities. Accordingly, efforts to strengthen enabling environments for women in STEM should be mindful of including all women, including through the following measures:

For economies, educators, and employers:

- Direct support for STEM education and lifelong learning opportunities in communities where representation of women in STEM is especially low, such as into minority communities, communities of vulnerable populations, and rural school districts.
- Focus on educational retention, workplace advancement, and leadership development for women in minority groups or other disadvantaged communities, who often have less access to mentors and advocates.
- Study examples set by successful groups for minority students, such as Black Girls Code, which was formed "to provide young and pre-teen girls of color opportunities to learn in-demand skills in technology and computer programming at a time when they are naturally thinking about what they want to be when they grow up." (Black Girls Code, 2016).
- Train decision-makers, managers, teachers and trainers about stereotypes that harm minority or disadvantaged communities. Teach them to understand and address unconscious bias that may discourage or intimidate minority girls and women from participating in STEM, including lack of mentorship or feedback or social or professional exclusion.
- Analyse salaries of all STEM workers, ensuring that overt or unconscious bias does not result in minority women experiencing disadvantages in their salaries and benefits.
- Help women find and draw support from other women who share their experiences. For example, the Women Chemists of Color network, formed within the American Chemical Society (ACS), builds community, provides resources, holds events, and advocates for minority women chemists in the United States. With membership of more than 150,000 people, ACS also has formed groups for chemists with disabilities, those of different ages, and those who identify as LGBT.
- Develop personal narratives of women in STEM who do not fall within the "majority." Providing these women an opportunity to share their stories in a way that is accessible to others can help them recognize their own achievements and inform their colleagues about their unique experiences.

From the APEC Women in STEM Survey: Economy observations about the Enabling Environment
• "Promotion of women and girls in STEM has not been prioritized and supported." • "Although [our law] enforces the government's educational responsibilities in pursuing gender equity, there are still not enough teachers, researchers, government officials, local NGOs participating in this task." • "Gender stereotypes: Girls are seen as less suitable than boys for science still prevail in the society." • "Women's personal beliefs, confidence in their own abilities, and motivational factors, reinforced by the social and cultural context, diminish their interest in the field." • "STEM-development policy lacks a gender focus." • "Institutional commitment, societal permission, and funding: Trying to get all to work together is a complex task."

- "Trying to identify solutions that address a broad population is enormously difficult as every situation is different."
- "Poor women lack access to basic goods & services."

EDUCATION

Promoting the inclusion of girls in STEM is a priority among APEC economies. The APEC Education Strategy, developed in 2016, includes a commitment to raising "the quality of teaching and learning, including in key subjects such as STEM," as well as a commitment among APEC economies to "work together to advance the participation of women and girls in these fields." (Draft APEC Education Strategy, 2016).

In this century, girls across APEC have achieved near parity in educational access. Reporting on the Women and the Economy Dashboard in 2015, the PSU points to great strides toward parity in literacy and enrollment in primary, secondary, and tertiary (university) education between 2008 and 2014 (Zhu, 2015). Moreover, gender gaps in the rate at which girls take math and science classes through high school have significantly narrowed. Although secondary-school aged girls still tend to study physics and computer science less than boys, they are nearly equally found in studies of biology, chemistry, and advanced math (AASSA, 2015; Hill/AAUW, 2015; Ellison, 2010). While high school boys continue to test somewhat higher than girls, the achievement gap in math has narrowed.

Still, the fact that the educational pipeline has improved has not yet resulted in a STEM workforce in which women are equally represented and advance to leadership positions at the same rate as men. Once they enter university, women in most APEC economies begin dropping out of the STEM fields at a rapid pace. Thus, the educational challenge for APEC goes beyond ensuring that girls test as well as boys, and into increasing "their persistence and resilience in STEM studies so that … early kernels of interest translate into meaningful careers." (Richmond, 2016). As detailed in this section, there are opportunities to do so at all stages of education.

Early and Primary Education

The first five years of life are considered among the most formative. Brains "hard-wire" information in ways that impact how students perceive information throughout their lives. (UNICEF, Facts for Life, 2010). Early education and primary school further present a critical opportunity to instill interest and confidence among girls in STEM-related pursuits. At that time in their lives, girls have not been fully inundated by discouraging stereotypes and media messages, and they remain relatively confident that learning presents for them as many opportunities as it does for boys. On the other hand, in the primary school environment, where teachers are, by large margins, often women, attitudes that "girls are not as good as boys at math" may be unwittingly perpetuated by the anxieties felt by the teachers themselves. (Azar, 2010). As early as 1st grade, the perceptions of all children become shaped by "implicit biases associating math with boys." (Corbett, 2015).

Moreover, in reviewing gender gaps in math testing results among teenagers, the OECD observed in 2015 that girls do not, at a young age, obtain "spatial skills" – that is, the ability to perceive spatial relations between objects – to the same degree as boys. Redoubling efforts to teach girls these skills may indeed "hard-wire" their brains for the long-term. (OECD, The ABC of Gender Equality, 2015). And, in considering the lack of women in

engineering and computer science, the American Association of University Women specifically encourages early contact between students and STEM professionals for the purpose of building awareness, confidence, and ability of girls to see themselves joining non-traditional fields as they grow. (Corbett, 2015).

As a threshold matter, of course, girls need to be able *get* to school. Parity in this regard has improved across the APEC region. For its part, in 2008, the People's Republic of China implemented nine-year compulsory education in both urban and rule areas. Since then, according to China's Women in STEM survey response, domestic primary net enrollment reached 99.8 percent and junior middle school enrollment reached 100%. China has also worked to strengthen educational access for millions of children of migrant workers, that is, workers with rural household registrations who work in urban settings.

Similarly, in Papua New Guinea (PNG), the introduction of "free" education in 2011 reduced the formal schooling costs for families and thus has lessened the economic burden of early education on families. Education is still not compulsory in PNG, however, which results in too many girls getting left out. (USAID/US-ATAARI, Women's Economic Participation in Papua New Guinea, 2013). In Peru, a series of policy reforms, including affirmation in 1996 of the government's commitment to free and compulsory education for children ages 7 through 16, has resulted in a substantial rise in educational attainment over the past generation. Yet, in certain rural and mountainous regions, more than 20 percent of females ages 15 and older remain illiterate. (USAID/US-ATAARI, Women's Economic Participation in Peru, 2016).

> "Acquisition of basic skills in STEM (scientific skills) starts from preschool in Malaysia. The National Preschool Curriculum (NPC) is compulsory for both public or private preschools and kindergartens. There are two components in NPC which are related to STEM, which are Early Mathematics and Early Science. In Early Science, children explore nature and the world around them, engage in inquiry learning and acquire basic process skills such as observing, comparing and grouping in the process. In Early Mathematics, children are exposed to number sense, early numeracy activities and simple problem solving activities. Methods of delivery include thematic learning, play-based learning as well as inquiry-based learning. The emphasis of STEM in NPC is important for promotion of inquisitiveness and to develop early science and mathematics process skills."
>
> *From* Sharing Malaysian Experience in Participation of Girls in STEM Education (2016).

And, of course, the quality of schools matters. Primary education as a springboard requires teachers themselves to have not only interest and confidence in introducing all students to STEM, but also the resources and institutional support to do so. Although teacher training in STEM topics is a priority across many economies, formal education can be slow to catch up with modern trends. Extracurricular opportunities, such as Girls Who Code and Girls Experience Engineering (detailed in this report's Annex, Table of Examples), assume an outsized role in introducing younger girls to STEM topics and building their confidence to pursue these topics throughout their education.

With respect to early education, suggested interventions that arose during this study focused on alleviation of stereotypes; early connection of girls with "non-traditional" pursuits and role models; extracurricular programs that develop early interest among girls in STEM pursuits; and the importance of the family. Representative examples include the GirlStart program to prepare 4th-8th grade girls to embark on higher-level high school math (United States); the Mindlab digital literacy program for primary-aged students and their teachers (New Zealand); and the "QCamp" for girls, a private initiative that expose girls in 3rd-6th grade to engineering skills and opportunities (United States). (Annex).

More generally, proposed interventions in the area of early and primary education include:

For economies:

- Continue to strive for open, free, and fair access to quality primary education for all students.
- Maintain regular and verifiable sex-disaggregated statistics on enrolment, achievement, and advancement to secondary school.

For families and educators:

- Pay special care during students' early years to avoid perpetuating gender stereotypes that may lead any child to believe that girls do not "belong" in STEM. Review texts, graphic representations, games, media, and other classroom and extracurricular materials that may inadvertently reinforce stereotypes.
- Integrate science and math concepts into play time. Conversely, make math and science lessons for all children fun and inspiring. In both cases, encourage girls to "tinker with things, take things apart, and put them back together." (Corbett/AAUW, Solving the Equation, 2015).
- Adopt "immersive teaching" techniques through which boys and girls participate together in hands-on activities. These can take place in traditional classroom environments, extracurricular activities, and at home.
- Emphasize spatial skills in girls' early learning, an area where gender differences become pronounced later in their educational paths. Emphasize to girls that intellectual skills, including spatial skills, are acquired – not "natural born."
- Welcome appropriate opportunities for girls to learn problem solving skills through video games.
- When creating STEM curricula, engage a variety of sources and perspectives, encouraging educators, STEM professionals, businesses, communities, parents, and students to communicate their ideas in an age-appropriate manner.

Mean PISA math scores of 15-year-olds by sex, 2012

Economy	Boys mean score	Girls' mean score
Australia	510.1	497.8
Canada	523.2	513
Chile	435.5	410.5
People's Republic of China- Shanghai	616	610
Indonesia	377.4	372.8
Japan	544.9	527

Secondary Education and TVET

A student's years of post-primary education present critical moments of choice. After early childhood, girls tend to make "gendered educational choices" that, whether unwitting or deliberate, may exclude them in the long run from pursuing careers in STEM. (Watt and Eccles 2009). In particular, the receptiveness of girls to STEM pursuits diminishes as they as they approach puberty. In fact, "the disparities appear and widen with successive levels of education." (Global Strategy to Empower Adolescent Girls, 2016).

Republic of Korea	562.1	544.2
Malaysia	421	494
Mexico	420.4	406.4
New Zealand	507.1	492.1
Peru	378	359
Russia	481.4	482.9
Chinese Taipei	563	557
Singapore	572	575
Thailand	419	433
United States	483.6	479
Viet Nam	517	507
Source: OECD		

To achieve a greater range of career choices in STEM, there is wide agreement that the predominating challenge lies in getting girls to take math. In the past generation, there has been increasing success in encouraging girls to persist with math *and* science, so that they are qualified to move forward at the university level in such areas as engineering, ICT, research in the sciences, and design. (Corbett/AAUW, Solving the Equation, 2015). Still, as evidenced by gender differences displayed in the 2012 Program for International Student Assessment (PISA) math exams for 15-year-olds, boys across APEC continue to out-perform girls for the most part (while, at the same time, girls out-perform boys in reading). Girls out-perform boys in math in two APEC economies – Malaysia and Singapore – and, in the Russian Federation, boys and girls have nearly identical mean scores. (OECD, The ABC of Gender Equality, 2015) (see table).

One notable observation from the United States is that, although gender gaps in math achievement persist across secondary schools, "there is enough variation from school to school to suggest that the number of girls reaching high performance levels would increase substantially if all school environments could somehow be made to resemble those where girls are currently doing relative well." (Ellison & Swanson, 2010). In other words, schools and economies engaged in math reforms have a lot to learn from one another. Successful practices in one environment are worth trying in another.

Secondary school is also a vital time for girls to learn about STEM careers and connect with STEM role models. It is also a critical period for cultivating resilience – that is, the ability to persevere in STEM, despite the inevitable challenges, including those that are traceable to gender. Certain interventions brought to light over the course of this study are designed to meet these challenges.

For example, in Japan, the Sony Science Program for Girls connects junior high or high school girls to female engineers working at Sony. The program exposes students to careers in engineering and offers experience with engineering through hands-on experiments in optical communications devices. In New Zealand, the Auckland-based STEM Ahead program connects mothers and their teenage daughters to women who work in science, technology, engineering and the arts. The program showcases careers of successful women and promotes after-school activities in STEM. In Australia, a New Innovators Competition offers scholarships to girls who submit the most original and innovative ideas for solving real-world problems.

In the United States, Girls who Code is a non-profit organization dedicated to closing the gap in technology. The program targets girls at the particular time in their lives when they might otherwise opt out. Through after school clubs (for 6th-12th grade girls) and summer immersion programs (for 11th and 12th grade girls), Launched in 2012, the summer program has embedded over 1,700 students inside a technology company or university setting for seven weeks at a time. Participants receive hands-on experience in computing concepts, programming fundamentals, mobile phone development, robotics, and web development and design. Daily classroom instruction is paired with talks, demonstrations, and workshops led by inspiring female entrepreneurs, CEOs, developers, designers, and computer science majors who serve as mentors and role

models throughout the program. The year-round Girls who Code after-school programs are similarly innovative, and have reached over 10,000 girls to date.

With respect to technical and vocational education and training (TVET), information on how economies strive to connect girls to STEM fields proved limited. Women in STEM survey responses show that efforts are underway in the Philippines, Chile, and Vietnam to strengthen gender equality in TVET programs, and to encourage more girls to embrace "non-traditional" fields, such as electronics, mechanics, and computer skills, where their chances of finding well-paid work improve. As one prominent example, Chile's Ministry of Education's campaign, "Let's Educate Equally," calls attention to gender stereotypes in TVET programs and helps teachers, students, and parents understand that boys, girls, teenagers and young people should make career decisions without constraints based on stereotypes. Materials prepared for this program include public service announcements on television, along with recorded testimonials aimed at a broad audience including elementary and middle schools students, principals, parents and teachers.

Practical ideas for interventions pertaining to secondary education and TVET that arose during this study include the following:

For economies:

- Continue to strive for open, free, and fair access to quality secondary education, including a range of TVET options, for all students.
- Maintain regular and verifiable sex-disaggregated statistics on secondary school and TVET enrolment, achievement, graduation, and progression to tertiary education.
- Prioritize girls' participation in high school math and science studies at the same rate and level of attainment as boys. Encourage girls to pursue available opportunities in calculus, physics, chemistry, computer science, and engineering. Where curriculum changes or updates result in fewer girls studying math, make immediate corrections.

For educators:

- Create "personal and personalized" learning environments, such that STEM education encompasses a variety of media, partners, schedules, and approaches – rather than a single methodology – to best meet the needs of each student.
- Work with girls through counselling, small groups, mentoring, and other activities to develop confidence and resilience and to discourage them from dropping out of higher-level math classes.
- Develop mentoring initiatives between university women and secondary school-aged girls. Connect girls in vocational programs with women in the STEM technical workforce as mentors.
- Create networks of girls and women, encouraging early mentorship across the STEM professions.

STEAM Camp:

Leveraging a Public-Private Partnership to Encourage Girls in STEM

The Women in STEM Framework underscores why a key part of APEC's efforts to build a regional pipeline of women in STEM fields must include outreach to adolescent girls and, specifically, must encourage girls to envision career paths in STEM. In July-August 2016, the U.S. State Department partnered with private sector companies and civil society organizations to do exactly that through the Women in Science (WiSci) STEAM (STEM + Arts and Design) Camp. Conducted in Spanish, the camp gave nearly 100 girls from Chile, Mexico, Peru, and the United States hands-on, exciting experiences that will help inspire and prepare them to go into STEM fields.

Private sector engagement in this initiative was critical to its success. Recognizing that girls are often most interested in careers that help people or make a difference in the world, Intel and Google showed campers how they can have a career in technology that meets those objectives. Google taught the girls how to develop their own apps from scratch using App Inventor, challenging them to create an app that can make technology more accessible for people with disabilities. Intel's training helped the girls learn how to improve or even save lives in their communities by building heart-rate monitors, digital music players, robotic cars, and windmills. Freeport-McMoRan sent a team of ten female engineers from Cerro Verde, the largest mine in Peru, to lead the girls through interactive stations on minerals, chemistry, and sustainability, opening their eyes to a range of unique career fields. Merck KgaA shared insight into health innovations and career opportunities in the biological sciences.

Beyond the curriculum, the camp focused on building the girls' confidence, developing their leadership skills, and empowering them to serve as role models in their own communities. The United Nations Foundation's Girl Up Campaign was an important partner in these efforts, selecting and training 10 camp counselors from the four APEC economies represented at the camp to facilitate sessions on leadership, public speaking, advocacy, and the Sustainable Development Goals throughout the camp. Girl Up representatives are also working with campers to establish Girl Up clubs at their schools. Throughout the camp, private sector partners and trainers served as mentors, meeting individually and in small groups with girls during "office hour" sessions. The girls were clearly encouraged by meeting women in the STEAM fields—over 80 percent of trainers were women—and by the end of camp, the overwhelming majority of campers said they had a very good understanding of career opportunities in STEAM.

Higher Education

Women in APEC are increasingly well represented in tertiary education and they show a growing presence in the STEM fields of study, especially in the biology and life-sciences. As evidenced by the UNESCO data that informs the APEC Women in the Economy Dashboard, the number of women in some APEC economies receiving graduate degrees in biosciences, including medical degrees, now surpasses that of men. However, beginning in university and even more so over the course of their careers, women are especially underrepresented in engineering and technology. (Figure 3).

What makes women choose to pursue those STEM fields in which they are most undersubscribed? In an effort to answer this question with respect specifically to computer science, Google surveyed 1000 women and 600 men in 2014. Half of the respondents were pre-college (that is, in the process of deciding whether to pursue a Computer Science major), while 50% were attending or had recently graduated from college (i.e., they had already decided whether to pursue a Computer Science major). Half of the respondents were interested in (or currently studying) Computer Science or a related field and half were not. From the data collected, Google drew the following conclusions about the factors that most influence a young woman's decision to pursue computer science:

- **Social Encouragement:** Positive reinforcement of Computer Science pursuits from family and peers.
- **Self-perception:** An interest in puzzles and problem solving and a belief that those skills can be translated to a successful career.
- **Academic Exposure:** The availability of, and opportunity to participate in, structured (e.g., graded studies) and unstructured (e.g., after-school programs) Computer Science coursework.
- **Career Perception:** The familiarity with, and perception of, Computer Science as a career with diverse applications and a broad potential for positive societal impact. (Google, 2014).

Once young women select university programs in STEM, the challenge is to help them *stay.* Although study in certain STEM majors may be highly collaborative, welcoming, and often fun, other fields can be unusually daunting, isolating, and even hostile to women. To help young women persevere despite the more negative conditions they may encounter, mentoring between university women majoring in STEM and professional women who have recently launched their own careers was repeatedly emphasized over the course of this study. As one example, Australia's Science 50:50 Program provides mentorship and networking opportunities to university women, focusing on early engagement and success of young women in the field. In Mexico, the federal government launched Codigo X, a mentoring program aimed at connecting civil society, the academy, government and industry to prepare girls and women for careers in ICT. Each participant works with a mentor who offers professional orientation, shares her own experiences, and helps her mentee find the resources she needs to reach her objectives. The mentors are women leaders with more than ten years of experience in the ICT industry.

As another approach to mentoring, the WeTech Qualcomm Global Scholars program, implemented by the Institute for International Education (IIE), links Chinese university women with volunteer mentors from Qualcomm offices around the world. The mentors are charged with providing support, career advice and guidance as students transition from university into the workforce. In 2016, the program, which also includes a valuable scholarship component, was extended to university women in engineering, computer science or other STEM fields in the Republic of Korea and Chinese Taipei.

In addition to the STEM participation of women at the undergraduate level, women's representation among masters' and PhD students tends to diminish relative to men. Statistics from a number of APEC economies illustrate the issue:

- In 2007, among Australian university Bachelor of Science students, women represented 52% of natural and physical science majors but only 15.5% and 18.9% of Engineering and Information Technology majors, respectively. (AASSA, 2015).
- In 2013, women in the Republic of Korea received 53.7% of the bachelor's degrees in the natural sciences but only 18.9% of those in engineering. Women accounted for 28.1% of all university students in science and engineering. Women receive 51.2% of master's degrees but only 36.7% of the doctoral degrees for natural sciences. (AASSA, 2015).
- In 2014, among science and engineering undergraduates in Malaysia, 48.1% were men and 51.9% were women. Specifically, 64.8% of science/computer graduates and 44.5% of engineering graduates were women. Among graduate students, women made up 43% of PhD students in science and technology. (AASSA, 2015).
- According to 2011-2014 statistics, women in engineering in the Philippines accounted for 42.8%, 39.5% and 58.0% in the BS, MS and PhD levels, respectively. The proportion of women is lower in some fields: physics (27.3%), applied physics (39.3%), electrical engineering (11.1%), and mechanical engineering (15.4%). (AASSA, 2015).
- While women in the U.S. receive over half of bachelor's degrees awarded in the biological sciences, they receive far fewer in the computer sciences (17.9%), engineering (19.3%), physical sciences (39%) and mathematics (43.1%). (AASSA, 2015).

In universities across APEC, moreover, women are underrepresented as faculty in STEM disciplines, thus depriving female students of experiencing women as mentors and role models in an academic context. Responding to the issue of low female representation on STEM faculties, Canada's Natural Sciences and Engineering Research Council funds five chair positions for women university faculty. Holders of the chairs contribute to Canada's domestic strategy to "raise the level of participation of women in science and engineering as students and as professionals." In the People's Republic of China, recognizing that success in academia is tied to successful research opportunities, the National Natural Science Foundation has adopted a series of policies to support women engaged in scientific research, including giving priority to women in the consideration of applications for the Foundation's research grants when women and men have the same qualifications; extending the age of women eligible for applying for the Young Scientist Fund to 40 years old; and agreeing that women can postpone their projects' conclusion where childbirth is a factor.

Throughout this study, a number of strategies emerged for encouraging university women to select STEM fields and stick with them through graduation and beyond. They include:

For educators:

- Tailor early STEM classes at universities to reflect and address the needs of young women, including their differences in preparation, which may be distinguished from those of young men. Connect issues problems that concern young women to opportunities to solve these problems through the STEM fields.
- Through proactive counselling initiatives, encourage women to enter STEM degree programs, working closely with them as they progress through their studies and helping them address concerns or cope with setbacks along the way.
- Sponsor social events and networking activities to help integrate women students into the STEM departments. Ensure comfortable places to convene and study and opportunities to connect young women with role models and mentors.

- Actively recruit and encourage the research activities of women faculty. Ensure mentorships among faculty members, and provide for flexibility in tenure schedules so that all faculty members do not miss out on tenure opportunities during the years they may be caring for small children
- Ensure diversity among leadership roles in STEM faculties, including as department chairs.
- Share experiences and knowledge gained from employing recent women STEM graduates with university STEM departments to help them refine their own programs in a way that encourages commitment and resilience among women.
- Participate in active and innovative mentoring programs for university women in the STEM fields.

Lifelong Education and Skills Training

For a number of reasons, opportunities to train in STEM beyond the traditional secondary school and university environments are important. First, the conditions under which women were taught as children can follow them throughout their lives. There are great variations in STEM achievement among girls of different levels of affluence or socio-economic backgrounds, and many women seeking training later in life may simply have to start from a very low foundation of knowledge. Second, after launching careers in non-STEM fields, many women find that supplemental training in STEM can connect them to better-paying or more rewarding work and promotion opportunities. Third, because women who do pursue STEM jobs are more likely than their male counterparts to leave work when they start families, opportunities in continuing education may be critical to their returning to and remaining in their fields. Increasingly, non-traditional STEM learning opportunities, such as short-term coding courses or technical skill "boot camps," or short adult learning programs in other science fields, can substitute to a certain extent for traditional degree programs. In this context, some engineering and computing occupations require relatively less investment of time and money in education compared with many other STEM occupations. (Corbett/AAUW, Solving the Equation, 2015).

A resource for lifelong education that emerged during research for the WE-APEC initiative is Women who Code, a global non-profit organization with numerous programs that help women become leaders and role models in the tech industry. Founded in 2011, Women Who Code's free professional development opportunities include the chance to learn new skills in various technology platforms or software packages, connect with experts and investors, and develop leadership skills. In Chile, Women Who Code has more than 200 members and sponsors free technical study groups and career and leadership development mentoring. In Hong Kong, China, the group similarly has more than 200 members and sponsors skills training for various coding languages, hackathons, and other events featuring influential tech industry experts and investors. In the United States, more than twenty-two cities have Women Who Code chapters, which organize a range of local and regional events, meet-ups, and training opportunities. (WE-APEC.com). In at least 20 economies worldwide, Women Who Code has reached over 80,000 people.

The Laboratoria Code Academy

Originating in New York City and now present in Peru, Chile, and Mexico, the Laboratoria Code Academy teaches students the technical and soft skills needed to start working as web developers. The program focuses on young women who typically have not had access to quality education. It encourages a range of people to apply, and those who demonstrate the highest potential are invited to join. Graduates pay back the cost of the course during their first three years of employment. The program focuses on five success factors:

1. ***Rigorous selection:*** Through personal evaluations, interviews, case studies and exposure to the basics of web development, Laboratoria identifies students who demonstrate potential to learn web development. Just one in three applicants is accepted to the program.
2. ***Market-oriented technical curriculum:*** Laboratoria monitors the tech industry to ensure it can provide students with the most needed web development skills.
3. ***Personal support and family involvement:*** In addition to technical expertise, Laboratoria focuses on "soft skills" needed to perform well at work. The curriculum integrates parents and guardians to ensure they that understand the program and support their students in their journeys.
4. ***Bridge to sustainable employment*:** Laboratoria evaluates students and provides an employment recommendation to those who are ready to work after graduation. The program connects students with potential employers, prepares them for their interviews, and supports them throughout their first year of employment.
5. ***Data-driven decisions:*** A monitoring and evaluation process starts with the application process and finishes three years after graduation. Lessons from this process help drive the development of the program.

As of 2016, Laboratoria's Code Academy has trained 400 women as coders, 75% of whom have gone onto university programs or jobs in the field. According to the Laboratoria website, program graduates earn an average of three times the wages they earned prior to commencing the program. Laboratoria's goal for 2020 is 10,000 women trained as coders, 85% of whom go on to university or the STEM workforce, earning four times their prior wages.

Sources: www.Laboratoria.la/en; APEC Survey Reponses, Peru and Chile, 2016.

Preparing and supporting women in STEM over the course of their lives should be available to *all* women – not just those with strong academic backgrounds, but also those who, while lacking significant foundations in STEM, have the desire and fortitude to launch their futures in the field. In Thailand, a consortium of organizations (including the Asia-Pacific Telecentre Network (APTN), the Thailand Ministry of Information and Communication Technology (MICT), the Research Center of Communication and Knowledge Management (CCDKM) and New Media4D) launched an ICT training program in 2013. The program focuses on four groups: the elderly, youth, women, and people with physical, hearing or visual impairments. By 2014, the program had reached 1,500 participants, building their understanding and proficiency in tech skills and job opportunities.

Another prominent example is Laboratoria, a Latin America-based organization of "social entrepreneurs who believe in the power of code." (See box). Although Laboratoria aims to be 100 percent self-sustaining by 2020, it has benefited from the support of a host of public and private sector partners, including the governments of Peru, Chile, and Mexico, as well as Microsoft, Google, and LinkedIn.

Policy recommendations in the area of lifelong education and skills training includes the following:

For economies, employers, and educators:

- Welcome the establishment of not-for-profit organizations that provide skills training to girls and women at all stages of their lives.
- Develop opportunities for women workers to diversify their skills and build new competencies through rapid training programs, including coding boot camps, which prepare them for well-paid jobs in the technology industry in condensed periods of time.
- Reach out to diverse populations, including vulnerable and less-educated women, to connect them with STEM skills, particularly in technology, that improve their employability and access to jobs.
- Develop apprenticeship programs that create pathways to entry-level positions and commit companies to participate.

From the APEC Women in STEM Survey: What are the key constraints toward educating women in the STEM fields?

- "Lack of self-confidence of women and girls to pursue career in STEM is often attributed to the persistence of several myths and clichés such as: a) women don't have the ability and drive to succeed in STEM; b) female faculty members are less productive than their male counterparts; c) women are more interested in family than in careers; and/or d) women take more time off due to childrearing, so they are a bad investment."
- "Lack of visible role models for young women to aspire to."
- "Lack of promotion of STEM career paths to girls and women in school and tertiary education."
- "Access to government funding & support, as well as research tools and equipment, is a challenge."
- "TVET systems are often gender-biased, affecting the selection of, access to and participation in specific learning programs or occupations for both men and women especially within the STEM education and training."
- "The proportion of female students enrolling in University (B.S.) in the field of STEM have been increasing. However, it is yet low in comparison with male students."
- "Unconscious bias, a lack of female mentors and role models, a lack of understanding about STEM and connections made between what students study in the classroom and how to apply STEM including in a way that attracts girls (i.e., show how STEM can promote social good and make things better in one's community), the "B-phobia" of girls—i.e., they want to be perfect and so if they get a B in a class, they may be more likely to drop the class."
- "There is increasing competition for the group of top high school students, with wide-ranging opportunities beyond STEM-related careers and many students perceiving these (e.g. careers in banking and finance) to be more attractive."
- "Personal values – namely, women tend to identify more readily with disciplines which are perceived to align with their intrinsic sense of "doing good" (e.g., biology)."
- "Marital responsibilities: A woman feels responsible for raising her kids, thus, sacrificing her need to undertake STEM courses or to further her studies."

EMPLOYMENT

APEC economies share the immense challenge of not only preparing and recruiting women for jobs in the STEM fields, but also retaining and advancing them in their fields. Although statistics on women's employment in STEM fields across APEC are limited, UNESCO's data show that, in research and R&D, there is considerable room for growth. (Figure 3). This section discusses the many aspects of a career in STEM, from a STEM worker's first job, to her opportunities for professional development and advancement over time. It also speaks to important junctures where women may leave their STEM jobs, and opportunities to help them return when they are ready.

Certification and Preparedness

One critical but often overlooked juncture in the "leaky pipeline" of women accessing STEM jobs is that of their general preparedness, beyond their secondary school or university degrees, to find and take on STEM-related jobs. This includes government-sanctioned eligibility to participate in certain careers — that is, formal licenses or certifications from their respective regulating authorities. In discussions and literature on women in STEM, little is made of this juncture. But in the previously noted study of women engineers in New Zealand, one of the key findings was the gap between men and women who seek to become Chartered Professional Engineers, an important designation of seniority. (IPENZ, 2015). Certifications are required in many STEM fields, including in lab jobs, various categories of engineering, accounting, and health and medical jobs, among others.

There is a more general aspect of career preparedness that benefits women entering the STEM sector: namely, networks in their fields. Of course, there are many professional organizations and networks open to all pertinent STEM professionals, and they afford many traditional benefits of improving scientific knowledge and connecting to research and job opportunities. But the opportunity for new professionals to participate in networks oriented specifically to STEM *and* women provides additional support. These include the opportunity to share experiences with colleagues who understand what they are experiencing and can offer support as they withstand the challenges of entering and staying in non-traditional jobs. A few examples from across APEC – detailed in this report's Annex – include New Zealand's Association for Women in the Sciences; the U.S.'s Association for Women in Science; Canada's Women in Communications & Technology; Peru's Women in Technology; and the Republic of Korea's IT Women's Business Association.

Potential interventions pertaining to certification and preparedness include the following:

For economies, educators, and employers:

- Where a job required formal testing and certification, provide assistance to women candidates throughout the process, including registering, paying, and studying for the exam. Failure need not be a reason to decline employment. Rather, additional time and assistance may be necessary to help the women achieve the certification.
- Ensure that post-university certification requirements emphasize mastery of learning, demonstrated through specific competencies, rather than measures of "seat time." Competencies should reflect knowledge and skills that are clearly identified, clearly applicable to job-specific situations, and measurable.
- Encourage new entrants to STEM careers to join professional organizations for the purpose of making contacts, developing awareness of professional growth opportunities, and building personal resilience.

Recruitment

Although women may enter STEM fields based on their awareness of the relatively strong job and salary prospects they offer, actually connecting to jobs that suit their abilities and interests has proven difficult in the past. Even as men and women find work at increasing parity upon graduation (Corbett/AAUW, Solving the Equation, 2015), women still can be stymied by perceptions that block them from jobs most suited to their interests and abilities. For example, women engineers and computing professionals remain likely to be evaluated as less competent, less hirable, and less valuable than identically qualified male counterparts. (Moss-Rancusin, 2013).

The surprising prevalence of unconscious bias in recruitment and hiring

A 2014 study from Yale University in the United States showed academic leaders in the STEM field regard a summary of accomplishments presented by a young male scientist more favorably than the same summary presented by a woman.

Despite identical summaries, professors at six major research institutions were not only found to be significantly more willing to offer the man a job, they set the woman's salary, if they did propose to hire here, nearly $4,000 lower than the man's. The bias against women candidates was held by men and women alike. (Moss-Rancusin, 2013).

Nonetheless, through consultations, interviews, and the June 2016 Women in STEM workshop, this study found that recruitment of qualified women has advanced considerably in recent years. Firms increasingly reach out directly to women applicants, including through programs in which they may have built relationships during their university studies. Recruiters are more diverse, and firms are more often prepared to discuss issues of particular concern to women, such as workplace flexibility and formal opportunities to work with mentors and continue learning on the job. Also in the survey, a number of firms pointed toward their recruitment practices that deliberately set out to make young women feel welcome and valued in their fields.

One good practice pertaining to recruitment is exhibited through Pacesetters, an initiative of the National Center for Women in Information Technology (NCWIT) in the United States. Pacesetters helps tech companies increase their diversity by increasing their appreciation for a diverse workforce and the instituting new recruitment habits and practices. For example, in 2014, Pacesetters prepared example technical job ads aimed at helping firms attracted a broader set of applicants. Other initiatives include challenging stereotypes that discourage positive behaviors, improving internal processes, and advancing technical innovation. According to the NCWIT, Pacesetter organizations have added or retained 2,650 women in the U.S. computing workforce since 2010.

In APEC's 2015 Women in Transportation Data Initiative and Best Practice report, recruitment of women into non-traditional fields – including engineering – is also identified as a critical juncture where the "leaky pipeline" can be addressed. Specific improvements to recruitment policy and practice cited by employers in that study include the following:

- Directing their recruitment campaigns to places where women are likely to see them;
- Removing stereotype-based images and content from company recruitment materials;
- Eliminating unnecessary employment requirements that may favor men (such as military service or strength requirements made obsolete through new technologies);
- Engaging more women as recruiters;
- Training interviewers and managers about special concerns of potential women recruits and how they may be addressed;

- Cooperating with local/regional work agencies or schools and universities to attract young women to the sector:
- Offering family-friendly work benefits that may be of particular interest to women;
- Holding managers accountable for advancing inclusion and diversity in the agency or firm through annual reviews and salary considerations.

(USAID/US-ATAARI, 2015).

Although certain STEM fields are able to recruit a diverse field of applicants, the technology and engineering fields have embraced a number of new ideas to increase diversity in their ranks. These further include:

For economies:

- Encourage firms to publically commit to gender-inclusive recruitment policies.
- Supply resources to small and mid-sized employers about how they can implement gender-inclusive recruitment policies and practices.

For employers:

- Establish well-supported diversity policies that are widely circulated and shared in initial meetings with all potential employees.
- Develop employer-university women in STEM mentoring programs. Connect university women to professionals who are relatively early in their careers, so they can discuss shared priorities at similar stages of their careers.
- Reach out to educational institutions where women in STEM majors are especially well represented, including women's colleges.
- Develop diverse slates of hiring personnel. Include women on initial interview teams, and make sure they ask questions and are included in hiring decisions.
- Create systems of "blind" CVs and job applications, removing names that identify gender.
- Refrain from requiring employees to report salary histories, so that biased systems of compensation are not perpetuated well into workers' careers.

Retention

The rate at which women leave their STEM jobs or the STEM labor force entirely is not consistently maintained across APEC. Still, general agreement found in reports and among expert observers confirmed that women are far less likely to stay in the field throughout their careers.

A multitude of complex reasons derived from this study explain the rapid rate at which women leave their STEM jobs. First, particularly in engineering and computer science, STEM jobs can be isolating and discouraging for women. Women also may encounter harassment, hostility or discomfort among men who are uncomfortable working alongside of them. There is immense room to dismantle "machismo" cultures that prize the relentless presence of men in the workplace and work against the robust participation of women.

Especially in more male-dominated work environments, conditions for STEM work can be inflexible and require long, continuous hours on the site of a project. Given that family and home-care responsibilities, in all cultures, are overwhelmingly assumed by mothers and daughters, women may find the "work-life" balance of STEM jobs untenable. Beginning in entry-level jobs, and worsening across their careers, women in STEM generally earn less than their male counterparts.

> *"Disappointingly high numbers of women leave the engineering profession. Work is needed to remedy this. The loss of skilled, experienced engineers is a loss to individual organisations, the leadership pipeline and the profession as a whole."*
>
> IPENZ, Women in the Engineering Workplace, Snapshot 2015

Compensation is another key aspect of retaining women in STEM fields. Although the gender gap in earnings tends to be narrower in engineering and computing occupations than in the overall labor force, it increases in significance as professionals in these fields advance in their careers. In the United States, women in the general civilian population make around 78 percent of the salaries earned by men while performing essentially the same work. For women in computer science and engineering, the gap ranges from around 85 percent (for computer systems analysts) to 92 percent (computer programmers). (Corbett/AAUW, Solving the Equation, 2015 (Figure A3)). In medicine – where women are considerably better represented – a September 2016 study of the Journal of the American Medical Association determined that, among physicians with faculty appointments at 24 public medical schools in the United States, significant sex differences in salary exist even after accounting for age, experience, specialty, faculty rank, and measures of research productivity and clinical revenue. (Jena/JAMA Internal Medicine, 2016). Wherever they may work in the STEM fields, if women do the same jobs as men, but believe they are not paid equally, their incentives to stay diminish.

Significantly, women seek and receive funding for their scientific research far less often than men. In the United States, for example, men submit three times as many proposals to the National Science Foundation than women. (Lockheed Martin, 2016). By publishing less, women are less likely to advance in their respective fields, and thus *more* likely to leave.

The Women in STEM study produced compelling examples of efforts to address the matter of retention. In Chinese Taipei, the Ministry of Labor encourages enterprises to promote work-life balance for workers in three fields: (1) autonomy and accomplishment in work; (2) care and family support; and (3) physical and mental health and safety. Methods supported by the Ministry include stress relief lectures, employee care courses, family-friendly measures, and temporary childcare spaces. In all, these activities have impacted more than 70,000 workers. The government also sponsors a "Work-Life Balance Award," commending best practices among employers.

In Japan, attention has been turned to the issue of helping women return to jobs they have left. The Japan Society for the Promotion of Science (JSPS) sponsors New Restart Postdoctoral Fellowships, which provide re-entry support for women who have dropped out of the STEM labor force for the purpose of childbearing and infant-raising. Similarly, in the United States, the Society for Women Engineers teams with the re-entry firm iRelaunch to create opportunities for women engineers who have taken time off but are interested in rejoining the field.

In the private sector, the Chevron Corporation operates a multi-faceted program called The Chevron Way: Engineering Opportunities for Women, which focuses on attracting, retaining, developing, and advancing women throughout the company. The Chevron Way incorporates targeted recruitment, leadership development activities, employee networks, firm mentoring and sponsorship. In particular, employee networks, along with Chevron's leadership development programs, offer opportunities for formal and informal mentoring. The Chevron Way initiative ensures accountability by tying performance evaluations to employee efforts to promote and sustain company diversity.

Another private-sector example pertains to helping women publish their research. In Japan, the Shiseido Group, a manufacturer of cosmetics and other personal products, offers three different funding opportunities to qualifying women: the Shiseido Female Researcher Science Grant, the JSID Shiseido Fellowship Award, and the Japanese Dermatological Association Basic Medical Research Grant.

Widely practiced interventions in the area of retention include the following:

For employers:

- In the workplace, set a tone for diversity and inclusion using messaging from top leaders. Challenge leaders to act as role models for the organization, and engage more women on leadership teams. As necessary, engage all levels of the organization to change the culture surrounding diversity and inclusion.
- Require diversity, inclusion, and bias training for officers and managers and encourage similar training for all members of the organization.
- Offer consultations or training for women in STEM jobs that addresses early career stages, development, confidence, and life coaching. Direct support in particular to newer, less experienced employees.
- Support women through mentoring programs. Reward exceptional mentors and share their practices and strategies for helping their mentees succeed.
- Strongly encourage women's participation in peer-reviewed research, including through training in proposal preparation; resilience coaching; participation on review panels; diverse review panels; research funding; etc.
- Make meaningful, satisfying part-time positions available to both men and women. Avoid assumptions that women will always be the "lead parent" in their families. Encourage managers to work part-time or flexibly to show all roles can be carried out in this way.
- Undertake pay equity audits and address any sex-based discrepancies they reveal.
- Evaluate managers on their ability to retain top female talent.
- Stay in touch with employees who take breaks from full-time work, and, where possible, support them in keeping their credentials current and skills up-to-date.

Leadership and Advancement

Women are emerging as leaders in STEM, but their numbers remain low, even in the context of their growing presence in the field. In STEM, leadership takes many forms, including substantive leadership through research, publishing, attainment of patents, recognition, and awards; leadership in professional associations, research consortiums, and academia; leadership over government and private-sector STEM-related agencies, offices, and firms; and more. Among "nontraditional" sectors generally, women often fail to advance at the same rate as men. As articulated by Catalyst, an organization dedicated to improving conditions for women and business:

> Male-dominated industries provide particular challenges for women's advancement …. [T]alent management systems are frequently vulnerable to pro-male biases that inevitably result in less diverse employee pools. Because senior leadership teams, which tend to be dominated by men, set the tone for talent management norms, masculine stereotypes can creep into HR tools. Employees who meet criteria (potentially based on masculine stereotypes) are selected for promotion and/or tapped as future leaders and/or offered development opportunities. Because male-dominated industries and occupations tend to be particularly vulnerable to masculine stereotypes due to lack of diversity,

women may find excelling in these industries or occupations to be particularly difficult. (Catalyst, 2013).

Progress in this arena requires at least two angles of intervention: first, building confidence and resilience among women so that they seek out leadership and advancement opportunities; and, second, deep consideration of institutional practices that may work against women, including with respect to performance awards, participation in cutting-edge work, sponsorship of promising women employees, access to leadership programs, and more.

With respect to the first angle, there are many opportunities for women to build their confidence and preparedness to lead a STEM organization, several – mentoring, networking, and recognition opportunities -- already mentioned in this report. Another example includes the AusBiotech Advancing Women Program, a six-month program specifically dedicated to advancing women in Australia's biotech/life sciences sector. Designed for emerging female leaders, the program uses coaching, research opportunities, and career advancement plans to equip participants to advance in their industries.

With respect to changing organizational culture, focused, dedicated, and accountable diversity initiatives are key, whether in government agencies, corporations, research, or university settings. Examples cited in this report's Annex include those implemented by Chevron, Qualcomm, and Freeport McMoRan. Key interventions articulated over the course of this study include the following:

For professional organizations:

- Proactively support the development and leadership of women, particularly in the male- dominated STEM fields. Encourage and create leadership programs within industry and professional organizations.
- Highlight and champion best practices in leadership and advancement among the STEM employers.
- Encourage firm or university-based mentoring and role models, leadership development and training, and networking opportunities.

For employers:

- Connect women employees to internal champions, who can represent their interests before advancement committees and counsel them on career their career progression..
- Ensure diverse groups of applicants for promotion, along with diverse selection panels.
- Maintain regular, sex-disaggregated data about internal advancements and promotions. Where there are clear differences in the rates at which men and women are promoted, identify and address gaps in opportunity.

ENTREPRENEURSHIP

As underscored by the Women's Entrepreneurship in APEC (WE-APEC) initiative in 2015, the place of women entrepreneurs in most economies continues to fall far short of its potential. Although data is scarce, conditions for entrepreneurship in the STEM fields appear to be even more skewed in favor of men. Across APEC and beyond, all enterprises established by women tend to be smaller and less likely to have joined the formal sector – where most significant opportunities for finance, markets, and growth lie – than those launched by men. Women-owned SMEs experience slower growth due to constraints on access to capital and assets – often found in weak inheritance rights or

systemic wage discrimination – and extend into comparatively limited access to markets, opportunities in capacity-building, leadership, and tools of innovation. (WE-APEC Report, 2015).

Opportunities and Skills

The opportunity to move from employment to entrepreneurship in the STEM fields is one that has long motivated scientists, engineers, and others, many of whom are eager to commercialize or further develop their own innovations or specialized research. Many large and influential firms – across the science, technology, and engineering fields – indeed started as small enterprises with humble origins. Even STEM enterprises that do not become large businesses are compelling to scientists as an opportunity for independence, autonomy, and influence in research and development. High-level scientists, particularly patent-holders, are often directly solicited by funders for the purposes of building their ideas into businesses.

Intensive start-up programs are growing in popularity. Start-up weekends or similar intensive training programs that offer focused coaching and training on starting a business or developing a business model are growing in popularity and have multiple private sector partners. Intensive programs are typically offered to both men and women, but women- focused weekends do occur. Private sector partners from a variety of industries – technology, finance, etc. – sponsor these programs and bolster name recognition for potential entrepreneurs. In addition, the infrastructure to set up these weekends is simple enough so that it can be done in both developing and developed economy contexts.

From US-ATAARI, WE/APEC: *Summary of Economy "Ecosystems" that support the establishment, Growth, and Success of Women-Owned Enterprises* (June 2015).

Just as women are the minority in most STEM fields, they are also significantly less present as STEM entrepreneurs. (Blume-Kohout, 2014). The decision to step away from full-time employment into entrepreneurship is not unfamiliar to women – but by far the majority of entrepreneurial women in the world do so to supplement family incomes on a small scale. Start-up of new STEM enterprises requires critical networks, champions, and connections that, relative to men, women often lack. A U.S.-based study sponsored in 2014 by the Small Business Administration found that women in STEM are less likely to leave their jobs for entrepreneurial endeavors, because, among other reasons, they did not feel equipped to give up the benefits they received through work, including health insurance. (Blume-Kohout, 2014).

Nonetheless, in 2015, the WE-APEC initiative uncovered a range of women who have successfully launched STEM-related enterprises, becoming important employers and leaders in their field. A number of these enterprises deliver STEM-related goods and services specifically targeted at women, such as cosmetics and women's health products. More commonly, the enterprises function in traditional retail areas, but take advantage of online marketing opportunities. Many entrepreneurs have benefited from both public and private-sector efforts to strengthen women's entrepreneurial skills and to help them connect with creative market opportunities within key value chains. (WE-APEC.com).

One comprehensive approach to entrepreneurial skill-building is found in Australia. Female Founders is a not-for-profit organization that supports women as they conceive, launch, and grow their enterprises. Through "meet-ups" and other activities, Female Founders offers training on "ambitious thinking"; funding landscapes; emotion and business; and growth and the essentials of scale. It also conducts a six-month mentorship program for new entrepreneurs. Similarly, the Rotman School of Management in the University of Toronto, Canada hosts a formalized Initiative for Women in Business. Since 2008, the initiative has supported women from "the classroom to the boardroom" by offering continued education, mentorship, and networking

opportunities. The program features a blend of practical knowledge and academic instruction, centered in three key areas: personal performance, leading growth, and transition support. (WE-APEC.com).

One idea that takes place "virtually" is Dell's Women Powering Business initiative, which connects a reported 10,000 female entrepreneurs across the globe with networks, sources of capital, knowledge, and technology. Through social media platforms, women connect and share advice, stories, and concerns. Participating women have access to Dell for Entrepreneurs, which provides information on technology, marketing, capital, and markets. (WE-APEC.com).

STEM Entrepreneurship in the United States: Key Findings

- Civil engineering, materials science, bioengineering, and mechanical engineering PhDs are more likely than PhDs from other STEM fields to engage in entrepreneurship.
- Industry sources fund a higher percentage of universities' mechanical engineering research, versus any other R&D field.
- Mathematics and statistics, agricultural sciences, and earth/environmental sciences have the lowest rates of industry-funded university R&D, as well as the lowest rates of entrepreneurship among PhDs.
- Male graduate students in materials science, chemical engineering and agricultural or earth/environmental sciences are more likely than female students in those fields to receive financial support from industry.
- Female graduate students in chemical engineering and mechanical engineering more often enroll in programs with no industry-funded R&D.
- In fields with the lowest representation of women among recent PhDs, female graduate students preferentially attend programs with higher percentages of female faculty.
- Among faculty in PhD-granting departments, female faculty is proportionally represented in top-ranked chemistry and chemical engineering departments.
- Female computer science faculty is more often found in lower-ranked departments, but with higher shares of industry R&D funding.

(Margaret E. Blume-Kohout, 2014).

Given the complexity of the arena, issues pertaining to the place of women in STEM entrepreneurship extend beyond the scope of this report. In general, however, there are a number of potential interventions that can help connect STEM women with entrepreneurial opportunity and skills:

For economies, educators, professional organizations, and not-for-profit groups:

- Support start-up weekends or similar intensive training programs that offer focused coaching and training on starting a STEM enterprise or developing a STEM business model.
- Connect women STEM entrepreneurs with networks that will help increase their awareness of resources, build their resilience, and expand their contacts.
- Integrate entrepreneurialism into STEM education generally, including a secondary and university levels. Help women navigate the connection between their innovations and the opportunities for entrepreneurship.
- Integrate gender issues associated with entrepreneurship into the curriculums of major business schools.
- Establish business incubators for women STEM entrepreneurs.

Access to Capital

Beyond relatively contained enterprises – such as consultancies – traditional STEM-related companies tend to require large sums of capital that most women cannot access. This is attributable to many factors, including the low representation of women in the venture capital industry. In 2016, the CrunchBase Women in Venture Capital Report found that less than ten percent of full-time investing partners in venture capital firms worldwide are women. It further found that companies established by men receive at least 85 percent of seed funding (funds that get a business started) and 90 percent of venture funding (money to launch or grow larger enterprises). (CrunchBase, 2016).

Under these circumstances, potential funders may not relate to or understand the STEM-related ideas of women entrepreneurs, particularly when the goods or services are directed at women consumers. Still, funding opportunities can come from a range of sources. For example, the "S Factory" is a program sponsored by the Chilean government and open to women with an approximate budget of USD $690,000 (460 million Chilean pesos). The objective of the program is to support women who are developing startups with high-growth potential. Beneficiaries receive approximately USD $15, 000 (10 million Chilean pesos) and have the opportunity, during a 12-week period, to meet with vibrant entrepreneurs from all over the world in a multicultural and collaborative workspace and access learning opportunities through courses, mentorships, and pitch training, among others.

A number of APEC economies have venture capital and angel investor networks that focus on funding woman-owned businesses, while also training other women to become angel investors and mentors to entrepreneurs. This type of initiative addresses both sides of the coin – the need for more financing for woman-owned businesses and the demand for more women investors, who are more likely than men to invest in women. Astia, a global not-for-profit organization, supports women entrepreneurs with guidance, capital, and connections to investors, corporate leaders, lawyers, bankers, and accountants. In 2014, Astia screened 250 companies, offered 110 companies access to advice from serial entrepreneurs and executives, and identified 57 as "investment-ready." Since 2013, Astia "Angels" have provided $5 million to 19 companies. (WE-APEC.com).

Potential interventions impacting women who seek capital to launch or sustain their STEM enterprises include the following:

For economies and funders:

- Promote gender diversity among lenders and investors, so that the value of the STEM enterprises developed by women is more likely to be noticed and taken seriously.
- Require gender diversity among STEM entrepreneurs who are invited to an event to discuss their ideas with investors. Increase the number of women working for venture capital firms. Ensure gender diversity on funding panels or committees.

For professional organizations and not-for-profit groups:

- Train women STEM entrepreneurs in accessing finance, including through business plans, connections to lenders, etc.
- Advocate for improved laws and regulations pertaining to credit.
- Pool funds to invest in woman-owned enterprises.
- Reach out to leading business associations, chambers of commerce, and investors to establish connections with the network.
- Bring together women financial professionals to share skills and information.

Access to Markets

To be sustainable, woman-owned STEM enterprises require markets. As detailed through the WE-APEC initiative, vibrant, sustainable markets arise from an ecosystem of support, including formal and informal business networks, opportunities arising through potential private-sector value chains, and government efforts to support entrepreneurs. Women who launch firms need support in developing their markets, both through marketing technologies and potential customers who will take them and their products seriously.

In Malaysia, some women entrepreneurs build their skills and awareness through a STEM-specific network. The E-Entrepreneurs Women's Association's mission is to "empower women entrepreneurs with ICT." EWA's objectives are to: (1) connect Malaysian women entrepreneurs who are involved in online business; (2) support women entrepreneurs' use of online business; (3) train members to use ICT for business productivity; (4) support members through activities; and (5) participate in studies and working papers related to EWA's mission; and (6) work with the government to advance EWA's mission. (WE-APEC.com). Perhaps most importantly, EWA runs an online marketplace for members to sell their products. Products available include food, handicrafts, and fashion items.

As observed through the WE-APEC initiative, access to markets is an area that could use further unpacking to develop solutions and activities that more effectively connect woman-owned businesses to revenue-generating buyers and clients. This is even more the case with the lightly explored area of women as STEM entrepreneurs. The proof of a program's effectiveness is whether woman-owned enterprises can attract new customers and grow.

Potential interventions include the following:

For economies, companies, professional organizations, and not-for-profit groups:

- Among business networks and trade associations, share information and develop tools that can benefit woman-owned STEM enterprises seeking to market their goods and services in other economies.
- Connect multinational companies that are experienced in promoting women and entrepreneurship with their large regional and domestic counterparts. Share best practices that translate to improving the domestic environment for women's STEM-related entrepreneurship.
- Invest in woman-owned STEM enterprises in creative, unexpected ways, such as by using their designs for economy-wide or international marketing activities or by procuring goods at a significant level (such as contracts for uniforms, catering, furnishing, services, etc.) that supply these enterprises with reliable cash flow that allows them to further improve their products and expand.
- Integrate women into corporate STEM supply chains, including through direct assistance that increases the capacity of high-potential, woman-owned STEM firms, including those whose own reach extends deep into domestic supply chains.
- Link women-owned STEM enterprises with the private sector and appropriate government agencies to educate them about of quality standards and key certifications required to market their goods and services abroad.
- Conduct a wide range of in-person networking opportunities where woman-owned enterprises may become aware of and introduced to potential buyers.
- Through social media, connect women to individuals and markets that they might not otherwise reach through conventional means.
- Provide information and training oriented toward supplier readiness, quality standards, timing, consistency and communication that must be met in order to each larger domestic and cross borders value chains.

- Advocate for increased market opportunities for woman-owned enterprises, including accessible and transparent public and private sector procurement mechanisms.

RECOMMENDATIONS

To this point, this report has focused on economy-specific conditions and opportunities for Women in STEM. Now, based on this foundation of knowledge and shared experiences compiled since February 2016, the APEC Women in STEM initiative is poised to support opportunities for APEC economies to work together to hasten the pace of change and enhance the cross-fertilization of key initiatives taking place across economies. The following recommendations are cross-cutting; that is, they implicate one or more aspect of the framework.

Review and reform legal and regulatory constraints to women's full participation in STEM. The World Bank's *Women, Business and the Law* initiative carefully delineates sources of workforce discrimination that lie in economy laws and regulations. The APEC Women and the Economy Dashboard highlights opportunities for economies to change these laws, with the anticipated result being that women may more freely participate in their economies, thus contributing to their families' welfare and economic growth. Since many of the restrictions impact women in non-traditional fields, the impact of dismantling discriminatory provisions may disproportionately impact women in STEM. Also, greater efforts to enact and enforce laws of sexual harassment may have a disproportionately positive impact on women in STEM fields.

Invest in and contribute to opportunities to both inform the general public about contributions made over time by women in STEM and reduce stereotypes against women's full participation in the sector. In nearly every walk of life, the contributions of women are underplayed in the history books or they received little notice at the time they were made. Across APEC's many work streams that touch on the STEM fields, there is an opportunity to highlight the historic contributions of women from all economies, creating a model for re-introducing women into contemporary understandings that may have left their contributions behind. Moreover, across APEC's STEM-related work streams, a discussion of gender stereotypes may prove illuminating and, in the long run, help economies broaden opportunities for the participation of women and girls.

Emphasize secondary math as a critical gateway for girls and women to move into STEM fields in all economies. The research is clear that math is the essential foundation for girls and women to compete on equal terms with their male counterparts in STEM professions over the course of their lives. APEC provides an excellent opportunity for economies to learn from one another in how to promote and most effectively teach math, and how *not* to lose girls in their secondary and early university years.

Ensure that STEM programs are responsive to students' needs, understanding that there are differing requirements among girls and women of varying levels of affluence or different cultural backgrounds. A number of examples cited in this report show how, when educators or trainers "meet women as they find them," they can help women from less privileged backgrounds make up for education they may have lacked earlier in their lives. Similarly, understanding that girls and young women arrive at school with differing levels of family support, it is useful for educators to shape their programs to address opportunities or expectations that women may lack at home.

Encourage routine and active sharing of STEM-related experiences, insights, and methods among educators, schools, and universities across the region. Through various working groups and policy initiatives, APEC already provides meaningful opportunities for economies to share information among professionals in the region. Supplementing these connections through year-round bi-lateral or regional institutional partnerships and exchanges can bolster the effectiveness of this work.

Develop and share models for private-sector promotion of inclusive employment, retention, and promotion policies for women in STEM, including gender-blind recruitment and scientific review policies and inclusive hiring and promotion practices. All over the world, larger corporations and employers are making public commitments to gender-inclusive actions, including through gender-blind recruitment, diversity in hiring and promotion panels, investment in women, and so forth. Monitoring the change that comes from these commitments and sharing and analyzing the data that emerges, can help inform other employers of their impact and benefits.

Ensure that women with STEM expertise are represented on all APEC committees, working groups, projects and other activities that incorporate STEM-related issues – including matters pertaining to the environment, agriculture, engineering, technology, etc. In recent years, APEC economies have significantly diversified the representation of their delegations and participants in APEC activities to include more women. By continuing to include women in all aspects of APEC's STEM-related work, women across the region are more likely to have their issues raised and heard.

Incorporate the specific concerns of women in STEM into the work of APEC institutions with a direct interest in Women in STEM, including the Human Resources Development Working Group (HRDWG) and the Policy Partnership on Science, Technology, and Innovation (PPSTI). In October 2016, APEC's Education Ministers endorsed a new Education Strategy, stating that they look forward to its implementation through the APEC's Education Network (EDNET) and other HRDWG networks in collaboration with other APEC fora and multi-lateral organizations. (APEC Education Strategy, 2016). Even before then, APEC conducted its first High-Level Policy Dialogue on Science and Technology in Education. In August 2015, participants in that dialogue acknowledged that "supporting and promoting Science, Technology, and Innovation talent mobility helps the sustainable development of societies and growth of economies." In addition, they "emphasized the need for diversity in academia and its importance in yielding high research productivity, intellectual capital, innovation and collaboration." They further affirmed "the importance of enhancing the participation of women and other underrepresented groups in scientific and technological fields and in higher education."(APEC *Joint Statement of the 1st High-Level Policy Dialogue on Science and Technology in Higher Education,* 2015).

Also in 2015, PPSTI released its Strategic Plan (2016-2025), which sets a pathway to "improve the quality of growth, promote economic and social development, address common challenges and achieve prosperity of the Asia-Pacific and beyond." Three overriding priorities are enunciated by the plan: (a) Building Science Capacity; (b) Promoting an Enabling Environment for Innovation; and (c) Enhancing Regional Science and Technology Connectivity. Although PPSTI's strategic plan specifically references the inclusion of women only with respect to promoting science and technological entrepreneurship, a number of its other proposed activities – including building science capacity and awareness, encouraging young innovators, and strengthening of STI ecosystems and networks – present important opportunities for strengthening the inclusion of girls and women.

Through these and other opportunities, APEC is poised to make significant and measureable progress toward advancing the participation and advancement of Women in STEM.

Continue promoting among economies the importance of sex-disaggregated data within all social and economic functions, including in the STEM fields. The insufficiency of data on women in STEM represents a missed opportunity that APEC can help remedy. Attentive monitoring of data enables stakeholders – including educators, employers, policy-makers, and more – to learn about promising and high-potential interventions. APEC economies can support this effort through conscientious monitoring and reporting of data as consistently defined and synthesized by international organizations, including UNESCO.

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ANNEX: APEC ECONOMY HIGHLIGHTS

As highlighted throughout this report, APEC is rich in activities focused on all elements of increasing Women in STEM. For each section of the Women in STEM framework, this section provides examples drawn from APEC economies. For every example, there are unknown scores or even hundreds of additional examples taking place in APEC economies and firms. The ones here are selected primarily from responses to the Women in APEC survey circulated in April 2019, with others from different sources added for the purposes of including a range of economies and perspectives.

APEC Women in STEM: Representative Examples of Promising Practices, Interventions, and Activities	
Enabling Environment	
Laws and Regulations	
People's Republic of China	**All-China Women's Federation (ACWF), "Research and Policy Recommendation for High-Level Women Talents."** Following a period of research and evaluation, the ACWF made recommendations for how departments of the Chinese government could improve or introduce more measures for the growth and development of high-level women skills and talents. This effort resulted in a number of initiatives. Among them, the Ministry of Science and Technology formulated *Suggestions on Enhancing the Construction of Women Talents Contingent in Science and Technology*, requiring that more effort be made to strengthen the training of high-skill women. The National Natural Science Foundation of China adopted a series of policies to support women engaged in scientific research, including giving priority to women in the consideration of applications for the Foundation's research grants when women and men have the same qualifications; extending the age of women eligible for applying for the Young Scientist Fund to 40 years old; and agreeing that women can postpone their projects' conclusion where childbirth is a factor. In 2011, the proportion of women recipients of the Young Scientist Fund increased by 10 percentage points, and the proportion of women who won the China Youth Science and Technology Award has increased by 18 percentage points than in 2010.
Japan	**4th Science and Technology Basic Plan**. Put into place by Japan's Cabinet Office and the Ministry of Education, Culture, Sports, Science and Technology in August 2011, this policy sets a goal to increase the percentage of female researchers in the natural sciences field to 30 percent. The Comprehensive Strategy on Science, Technology and Innovation, instituted by the Cabinet in June 2013, reiterates this goal, which is included in the Science and Technology Basic Plan 2014, decided by the Cabinet in June 2014.
Papua New Guinea	**National Public Service Gender Equity and Social Inclusion (GESI) Policy.** This policy provides guidance to domestic Public Service agencies in addressing gender equity and social inclusion issues within their own workplaces. Its aim is to ensure that relevant values and principles are adopted into long and short-term strategic planning, enabling agencies to collaborate with other stakeholders to address this issue in the National Public Service. All PNG departments, provincial and domestic level administrations, and other agencies are charged with integrating the guidelines and principles for gender equality set out in the document.
United	**MissionSTEM.** In November 2012, the National Aeronautics and Space Administration

States	(NASA) launched "MissionSTEM," a website designed to assist NASA grant recipients across the economy, including universities, science museums, and science centers, to meet their obligations under civil rights laws, including Title IX, which provides for full equality of girls in education. The website enables NASA to broaden the reach of its civil rights technical assistance to its grantees, augmenting civil rights compliance reviews. In addition to describing the baseline civil rights requirements for NASA grant recipients, MissionSTEM encourages diversity in STEM fields by sharing promising practices of leading universities and featuring university presidents and provosts describing the importance of diversity in STEM fields, including gender diversity, on the MissionSTEM website.
History and Awareness	
Canada	**The Alice Wilson Award .** The Alice Wilson Award was established by the Royal Society of Canada (RSC) in 1991, on the request of the Committee for Advancement of Women in Scholarship, to honor the memory of Alice Wilson (1881-1964), the first woman elected to become a Fellow of the RSC. Dr. Wilson was a world-renowned paleontologist and one of Canada's foremost geologists. Her career with the Geological Survey of Canada lasted from 1909 to 1946, while she advanced from museum assistant to geologist. In addition to her research contributions, she brought geology to the public, especially to children, in many ways. The $1000 cash award is given yearly to three women of outstanding academic qualifications in the Arts and Humanities, Social Sciences or Science who are entering a career in scholarship or research at the postdoctoral level. Recipients are chosen from the current year's female winners of postdoctoral fellowships from the three granting councils.
Chile	"**Let's Educate Equally."** Chile's Ministry of Education endeavors to eradicate gender stereotypes in vocational training nationwide. Its Campaign, "Let's Educate Equally" takes place in cooperation with an NGO called Comunidad Mujer (Woman Community). The campaign calls attention to gender stereotypes in the classroom, helping teachers, students, and parents understand that boys, girls, teenagers and young people should make career decisions without constraints based on stereotypes. Materials prepared for this program include public service announcements on television, along with recorded testimonials aimed at a broad audience including elementary and middle schools students, principals, parents and teachers.
United States	**The Untold History of Women in Science and Technology**. Created by the White House Office of Science and Technology Policy, this online repository features stories about women trailblazers in STEM. An audio component captures women in the Obama administration's stories of their own STEM heroes. The resource sets an example of "writing women scientists into history" so that educators and employers can be more mindful of including women as examples of leaders in the sector.
Encouragement and Inclusion	
Australia	**Male Champions of Change.** An initiative of the Sex Discrimination Commission, MCC is a coalition of male leaders who advocate for gender equality within companies, organizations and communities. In 2013, MCC created a 12-point action plan of concrete steps members have pledged to make at their organizations to increase gender equality. The 12 points fall under four categories of action: (1) stepping up as leaders; (2) creating accountability; (3) disrupting the status quo; and (4) dismantling barriers for caregivers. This creates accountability that MCC considers necessary to make sustainable change over time. Concrete actions include the active cultivation and selection of women as leaders in the top management team, the "Plus One" initiative encourages senior managers to have at least one female manager on their team as openings arise; the "Supplier Multiplier" commitment encourages male CEOs to diversity their supplier base; and the creation of flexible workplaces. As of April 2015, the heads of PwC Australia, Medibank, Toll Group, the University of Melbourne, among others, have all joined and made commitments.

Canada	**Chairs for Women in Science and Engineering Program.** The CWSE was launched in 1996 by the Natural Sciences and Engineering Research Council (NSERC). Its goal is to increase the participation of women in science and engineering, and to provide role models for women active in, and considering, careers in these fields. The program is regionally based, with one Chair for each of the Atlantic, Quebec, Ontario, Prairie, and British Columbia/Yukon regions. Each Chair lasts for five years. The two newest Chairs in the program were announced in May 2015, making it a total of 12 active NSERC's CWSEs.
New Zealand	**STEM Ahead.** An Auckland-based initiative, STEM Ahead enables mothers and their teenage daughters to meet women who work in STEM professions. The Program showcases the careers of successful women and promotes after-school activities.
United States	**Women Enhancing Technology Program (WeTech).** The Qualcomm company is a lead partner in WeTech, which is dedicated to constructing a healthy pipeline of girls and women in STEM education and ICT careers, linking them to university scholarships in engineering, leadership and technical skills training, mentors and scholarships. Supported by the Clinton Global Initiative, WeTech helps girls and women, from 5th grade to adulthood, to connect with each other, to learn about STEM opportunities, and to enhance their own technology skills.
United States	**FabFems.** Created by the National Girls Collaborative, with collaboration from Motorola Solutions Foundation and the National Science Foundation, FabFems is a one-stop shop for women in STEM careers. It is a domestic database that compiles names and contact information of women who want to serve as role models or offer education and STEM career advice. FabFems connects girls who might not have a STEM role model in their lives with a professional that can show them why these careers are attainable and rewarding. Teachers can browse FabFems to find STEM guest speakers or field trip opportunities in their area. An interactive visit to a lab is an effective way to get students (girls) interested in science. The website also works as a networking tool for STEM professionals. Groups of STEM role models have met through FabFems and teamed up to volunteer with organizations in their area serving girls such as the Girl Scouts.
Education	
Early and Primary Education	
Australia	**Science 50:50.** Launched in January 2015 and housed within the University of New South Wales, this program motivates young girls to pursue degrees and careers in science and technology. The program provides sponsors school visits, mentoring, and networking opportunities, and a "new innovators competition." In addition, the program is developing online resources developed with the help of universities, research institutions and the private sector. In the area of history and awareness, the program is creating a video series that features "extraordinary women in research, industry, media and politics" and showcases Australian innovators, to link aspiring girls and young women to 50:50 mentors.
Malaysia	**Sharing Malaysian Experience in Participation of Girls in STEM Education.** In 2016, the Malaysian Ministry of Education, in cooperation with UNESCO, published a concise but thourough discussion of the many dimensions of the government's efforts over time to strengthen the presence of women in STEM. The document reads as a toolkit, in which education and STEM professionals can learn through specific examples how Malaysia has developed its formidable workforce of women in the STEM fields, one of the strongest in the world.
New Zealand	**The Mindlab.** This project is a collaboration between a public education provider, Unitec, and a specialist education lab, Mindlab, that is dedicated to enhancing digital literacy capability and the implementation of contemporary practice in the teaching profession. The program targets primary school-aged children and their teachers, and offers 4-week programs, holiday programs, and a post-graduate certificate in digital and collaborative learning.
United States	**Techbridge Girls.** Launched in 2000, Techbridge has worked with over 4,000 girls in grades 5-12 through after-school and summer programs in the San Francisco Bay area to provide resources to expand the academic and career options for girls in STEM. In partnership with

	Techbridge, the Chevron company has committed $10 million to the Fab Foundation, an organization that supports innovation, invention and learning centers globally, to design "girl-friendly" educational after-school programs in formal as well as informal education to advance girls in STEM.
United States	**Girlstart.** In an effort to engage girls in STEM before the critical selection period into pre-Advanced Placement math and science courses, Girlstart leads highly interactive STEM-based, yearlong afterschool activities, summer camps, and community events for girls across the United States. Girlstart received a four-year grant from NASA education that runs from 2012-2016. Girlstart aimed to reach over 14,500 4th-8th grade girls and over 800 educators for a total of nearly 69,000 participants. In 2016, Girlstart initiated the first phase of a research plan to determine the impact of "Girlstart After School" on girls' academic progress and advanced STEM course selection. Preliminary results from two of the serviced districts show significantly higher state testing scores and more pre-AP math and science courses taken by Girlstart participants.
United States	**Qcamp for Girls in STEM**. A three-year program focused on developing and advancing STEM-related capabilities for middle schoolgirls, Qcamp was first launched in 2014. The initiative is a collaborative effort between Qualcomm, the Institute of International Education, and the Children and the Youth Science Center (CYSC). The two-week camp for 30 rising 6th grade girls exposes Qcampers to a variety of engineering hands-on experiences and the pathways and careers that utilize these experiences. Qualcomm engages Qcampers throughout the program, and later during the schoolyear, including through mentoring opportunities, hackathons, and tinkering events with Qualcomm employees. In particular, the camp has shown impact on: fascination, emotional and cognitive attachment (curiosity, positive affect, and obsession) with natural and physical phenomena as well as STEM topics and tasks.
Secondary Education and TVET	
Australia	**CSIRO's Indigenous STEM Education Program.** Alongside the support of the BHP Billiton Foundation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has implemented a program aimed at increasing the participation and achievement of Aboriginal students in STEM fields. The program is comprised of six elements: i) economy projects as the context for learning science linked to Indigenous ecological knowledge; ii) tools and support to improve mathematics outcomes for students; iii) Indigenous STEM Awards that recognize students, teachers, schools, scientists and STEM champions that have been participating in the Indigenous STEM Education Project and from Indigenous STEM professionals domestically; iv) hands-on inquiry-based projects to increase student engagement and achievement in science; v) an aboriginal summer school program that targets high-achieving Year 10 students and provides support into years 11 and 12; and vi) a degree program that supports high potential students, who require financial assistance and access to education, through the completion of Bachelor of Science degree at the University of Melbourne.
Canada and the United States	**EngineerGirl.** The EngineerGirl website is designed to bring domestic attention to the exciting opportunities that engineering represents for girls and women. The site was launched in 2001 with input from a specially selected Girls Advisory Board—bright, energetic girls from all over the United States and Canada. In 2012, a new Girls Advisory Board was formed in order to re-design the site for a modern audience website is a service of the National Academy of Engineering (NAE) and grew out of the work of the NAE Committee on the Diversity of the Engineering Workforce. EngineerGirl program has three primary objectives: • Encourage students to learn about the role of engineers in daily life via an annual essay contest. This contest is managed by NAE staff and supported by numerous volunteers who help to score hundreds of essays. • Provide girls and individuals who work with girl's access to female

	engineering role models. This access is provided through interviews, essays, and the "Ask Me a Question" feature on the EngineerGirl website. Encourage girls to learn about engineering and think about preparing for an engineering career by providing new and interesting content (blog articles, fun facts, quizzes, etc.) on the website. Content is presented in a girl-friendly format and demonstrates that engineering is rewarding, interesting, and accessible to women. Total program costs are approximately $315,000 per year.
Japan	**Sony Science Program for Girls.** Held at the Science Festival at Ochanomizu University, this initiative connects young women in junior high or high school to female engineers working at Sony. The program provides participating students exposure to a career in engineering and gives them firsthand experience with engineering through hands-on experiments in optical communications devices. Sony/Taiyo Corporation staff also lecture on the importance of diversity and inclusion in society.
New Zealand	**Futurintech.** The Futureintech program brings technology, engineering and science-related professionals into schools. By sharing their experiences and pathways, these STEM professionals inspire young New Zealanders to explore careers in areas that they may not otherwise consider. Futureintech is run by the Institution of Professional Engineers New Zealand (IPENZ) and funded through Callaghan Innovation and the Ministry for Primary Industries. The program's goals are to: • Increase the proportion of technology, engineering and science enrolments amongst total enrolments in tertiary study • Raise the profile of careers in technology, engineering and science as highly desirable • Offer students realistic learning experiences in technology, engineering and science • Establish co-operative relationships between industry and education communities.
Philippines	**Raising the Bar in the TVET Sector for 21st Century Learners.** In September 2015, the Philippines' TVET authority (TESDA) organized a symposium attended by around 600 participants from public and private technical vocational institutions, non-government organizations, domestic government executives and industry representatives. The gathering highlighted the importance and effectiveness of TVET and generated information on industry prospects, opportunities and implications that could ensure the delivery of quality TVET education. Under the K to 12 policy, all students must go through kindergarten, six years of primary education, four years of junior high school, and two years of senior high school. In high school, students can choose from the four tracks: STEM academic, sports, arts and design, and technical-vocational-livelihoods.
United States	**University of Memphis: Girls Experiencing Engineering.** The University of Memphis operates the Southeast Transportation Workforce Center (SETWC), which has implemented a Girls Experiencing Engineering (GEE) program since 2004. The GEE program is an immersive, 20-hour intensive session for girls in middle school and high school. GEE also involves high school and colleague peer mentors, as well as math and science teachers. GEE has six primary objectives: demonstrate connections between math, science, and engineering; highlight career opportunities in the field; design realistic applications through engineering-based design challenges; develop leadership skills; provide teachers with instructional methods training; and provide parents with information about engineering opportunities for their children. The GEE program exposes young girls to engineering opportunities through a holistic community approach, involving peers; instructors; mentors; and parents.
United States	**Youth and Technology Design Challenge.** Led by JPMorgan Chase, this initiative works with girl-focused youth nonprofits, including Geek Girls, Girl Scouts and iMentor, to introduce

	young women to technology. Piloted in 2015, the Challenge aims to increase the number of youth interested in STEM and technology and introduce students to JPMorgan Chase as a potential future employer. Through the Youth and Technology Challenge, students have the opportunity to visit JPMorgan Chase offices for a day to work on teams to rapidly solve real problems for a non-profit organization. In addition, the students receive mentorship and guidance; interact with nonprofit representatives; and design their own visions for a technical solution and learn to use Balsamiq, a wire-framing and mockup tool.
United States	**Girls Who Code Summer Immersion Program.** These programs work to inspire, educate, and equip girls with the computing skills to pursue 21st-century opportunities. The Girls Who Code Summer Immersion Program is a 7-week computer science course that embeds classrooms in technology companies and universities. Students learn the fundamentals of computer science - from robotics to how to build a webpage - while gaining exposure to the tech industry and mentorship from women working in technology. The program embeds 20 rising high school juniors and seniors inside a technology company or university setting from 9-4PM each day. Participants receive hands-on experience in computing concepts, programming fundamentals, mobile phone development, robotics, and web development and design. Project-based curricular modules allow participants to build products and develop innovative solutions designed to inspire an interest in and encourage their pursuit of computer science. Daily classroom instruction is paired with talks, demos, and workshops led by inspiring female entrepreneurs, CEOs, developers, designers, and computer science majors who serve as mentors and role models throughout the program, each aligned with the subject matter discussed that week. Since 2012, the Summer Immersion Program has grown from 20 girls in one city to reaching nearly 2000 girls in ten cities across the economy.
Chile, Indonesia, Peru, United States	**Freeport McMoran**. Primarily a mining company that is based in Phoenix, Arizona, Freeport is the largest copper and molybdenum producer in the world. Freeport-McMoRan has invested approximately $4 to 5 million in the U.S. alone since 2010 to strengthen the STEM education pathways and the inclusiveness of women and girls. The programs that the company supports are targeted toward improving students' achievements and outcomes in STEM disciplines ultimately to inspire their pursuit of post-secondary degrees or career and technical certifications as well as careers. Examples of these programs include: STEM innovation grants and Discovery Education's Dig into Mining. The grants are designed to support K-12 teachers and schools in their efforts to develop, improve or expand innovative instructional programs in STEM. Since its founding in 2008, more than $680,000 has been invested in STEM projects benefitting K-12 schools in Freeport-McMoRan communities. *Dig into Mining* is a partnership program between Discovery Education, a digital learning initiative created by the Discovery Channel, which allows students in grades 6-8 a deeper understanding of the rock mining industry through interactive activities such as virtual field trip, interactive digital learning tools, and school-to-home connections with career exploration activities where they can uncover the use of transition metals such as copper, gold and molybdenum in everyday life.
Viet Nam	**ADB, Viet Nam Skills Enhancement Project.** Begun in 2010, the Skills Enhancement Program aims to strengthen Viet Nam's formal TVET system in a way that integrates modern technologies into the industrial and service sectors. The program strives to address gender inequity and open doors to women, including through social marketing, targeting of poor rural areas and attracting more women into male-dominated industries. The program is supported by a US$70 million loan from the ADB's concessional Asian Development Fund. The program focuses on the automotive technology, electrical and mechanism manufacturing, hospitality and tourism, information and communication technology, and navigation and shipping industries. The program provides management and instructor training in 15 public and five private vocational colleges in five economic zones. The ADB has also developed a detailed set of materials guiding the development, implementation, and monitoring and development of the

	program.
	Higher Education
Chinese Taipei	**Gender awareness and development program for female college/university STEM students and teachers.** This program at the University of Taipei aims to enhance gender-awareness of teachers and college students in math and science through various activities, such as camps, seminars and workshops. A two-day camp for 34 students features seminars addressing the technology gender gap and women's rights; journals from Chinese Taipei's women scientists, and activities highlighting gender issues in STEM. The 2015 program also included a visit to the Chinese Taipei Fuji Condoms Discovery Center, run by the economy's biggest condom manufacturer, Fuji Latex, with the aim of giving students better understanding about contraceptives. The program also includes seminars and exhibits about gender awareness and curriculum design for 42 STEM teachers. Workshops for teachers feature paper rockets, experiments with solid propellant, circuit boards, and atmospheric pressure hands-on experiments. In 2015, more than 345 teachers participated, with program evaluations showing 90% satisfaction.
Chile	**Women in Science**, Comisión Nacional de Investigación Científica y Tecnológica de Chile (National Commission for Scientific and Technological Research) (CONICYT). Established in 1967 by the Ministry of Education, CONICYT advises Chile's President on scientific development. Today, CONICYT supports a comprehensive policy of training, integration, and recruitment of researchers and professionals and supports scientific research and technological development in Chile. Started in 2012, the Women in Science program seeks to close the gender gap in the sciences by encouraging women's participation and developing gender equality policies at universities. CONICYT also provides financial support for gender research by female professors and publishes research by Chilean women in the sciences on its website.
China and United States	**Developing the Next Generation of Leaders in China: The WeTech Online Mentoring Program.** Sponsored by Qualcomm, WeTech is a customized virtual mentoring program that links young women in China with tech leaders across the world. In its pilot phase, WeTech targeted university women in China as mentees, linking volunteer mentors from Qualcomm offices around the world with the university women, and providing support, career advice and guidance as students' transition from university into the workforce.
United States	**Million Women Mentors.** MWM is a program that supports the engagement of one million STEM mentors (male and female) to increase the interest and confidence of girls and women to persist and succeed in STEM programs and careers. MWM is an initiative of STEM connector in collaboration with over 45 corporate sponsors and 35 state leadership teams. The program does the following: • Encourages corporations to join MWM and capture metrics pertaining to girls and young women in STEM. • Provides an automated, scalable, and user-friendly platform that helps STEM professionals (male and female) become effective mentors, in partnership with 60+ domestic organizations reaching over 30 million girls. • Matches participating corporations with non-profit partners and educational institutions in need of STEM mentors and role models. • Builds and supports state teams to execute MWM at the domestic levels • Recognizes best practices in mentoring girls (middle school through career-level) in STEM.
United States	**Diversity Engineering Collegiate Alignment (DECA) & Qualcomm Women's Collegiate Conference.** This collegiate program, which is led by Qualcomm in collaboration with the Institute of International Education, has helped Qualcomm attract a diverse pool of interns and future employees. Between 2014 and 2015, the

	percentage of women in Qualcomm's internship program increased by 30 percent, with the overall representation of women in the company's internship program growing from 14 percent to 26 percent over the last two years. The effort increases the diversity of Qualcomm's employee population, as the company identifies new employees through the program.
	Lifelong Education and Skills Training
Thailand	**ICT training for underprivileged workers.** This program was started in December 2013 by the Asia-Pacific Telecentre Network (APTN), the Thailand Ministry of Information and Communication Technology (MICT), the Research Center of Communication and Knowledge Management (CCDKM) and New Media4D. It offers ICT training to four groups of people: the elderly, youth, women, and people with physical, hearing or visual impairments. In 2014, it reached 1,500 participants, building their understanding and proficiency in tech skills and opportunities.
Peru, Chile, Mexico	**Laboratoria Code Academy.** Laboratoria teaches students the technical and soft skills needed to start working as web developers. The program focuses on young Latin American women who have not had access to quality education. It encourages a range of young women to apply, and those who demonstrate the highest potential are invited to join. Graduates pay back the cost of the course during their first three years of employment.
Hong Kong, China	**Women Who Code.** A global nonprofit dedicated to inspiring women to excel in technology careers, Women Who Code creates a connected community of women in technology. Hong Kong, China's chapter of Women Who Code links the economy to one of the largest communities of women engineers in the world. The chapter sponsors skills trainings for various coding languages, hackathons and other events featuring influential tech industry experts and investors, and career and leadership development training. Women Who Code HK has a Facebook group with over 200 members.
Philippines	**i-Pinay.** This program, launched in 2013, focuses on health, entrepreneurship and digital literacy. It is implemented by the Philippines Community e-Centers Network (PhilCeCNet) and the University of the Philippines Open University, which leads the curriculum development and program implementation. By March 2013, 11 centers had committed to train 4,400 women under the initiative. i-Pinay was the successor to a similar program implemented between 2011 and
United States	**Tech Connect.** A four-week specialized program created by JPMorgan Chase with a focus on career development and Java training was launched in 2015 with conducts in Jersey City and Bournemouth. Following this primer, analysts move into our intensive six-week bootcamp and two-year Technology Analyst Program. The program focuses on welcoming individuals from under-represented pipelines of talent, including women, African Americans, and Hispanics. The program's main components include providing support focusing on: technical acumen, mentorship, network building and career development.
	Employment
	Certification and Preparation
Malaysia	**Institution of Engineers Malaysia (IEM), Women Engineers Section.** Consisting of around 15 percent of the 78,800-member IEM, the Women Engineers Section was formed for the purpose of connecting women in the engineering profession and creating alliances among engineering professional bodies to inspire, support and celebrate women engineers in their professional development. The Section has taken on a number of challenges, beginning with an effort to bring many more women engineering students into IEM membership – from around 3,000 in 2013 to nearly 8,000 in 2016. The Section has six chapters located across the economy: Southern, Perak, Penang, Miri, Pahang and Sabah. In addition, the Section surveyed its women members, finding, among other conditions, the following: (a) 22% of respondents said they had experienced gender discrimination; (b) 13.6% reported experiencing gender harassment in the office or on site; (c) 25% felt that their professional opinions were not accepted because they were women; (d) 55.4% had been given the opportunity to handle

	high-profile projects; and (e) 90.5% women engineers felt confident to make decisions at meetings or give instructions at sites. From there, the section has engaged in outreach to university students, bringing engineering awareness into schools, promoting awareness through a gender equality essay contest, and other efforts to build camaraderie and resilience among its members. In 2017, the IEM will host the International Conference on Women in Science, Engineering and Technology (WiSET).
Mexico	**Código X.** In April, 2016, Mexico's federal government launched the mentoring program entitled Codigo X, which aims to connect civil society, academy, government and industry to prepare girls and women for careers in ICT. Each participant works with a mentor who offers professional orientation and shares her own experience in order to inspire her mentee and help her find the necessary resources to reach her objectives. The mentors are women leaders with more than 10 years of experience in the ICT industry.
New Zealand	**Association for Women in the Sciences (AWIS).** AWIS is a network for women interested in or working in the sciences. It assists women in gaining confidence in their role in science, and provide visibility for women working in the sector. This takes place through regional events where members can network, discuss and learn from other women in science. Triennial conferences bring together women from across New Zealand to share ideas, AWIS sends a monthly newsletter to members featuring information of relevance and interest to women in science and preparing submissions to government and other bodies on issues relating to women and science.
United States	**Association for Women in Science (AWIS).** Founded in 1971, the AWIS is the largest multidiscipline organization for women in science, technology, engineering, and mathematics (STEM) that advocates for full participation of women in all STEM disciplines across s all employment sectors. AWIS reaches more than 20,000 professionals, 30 percent of whom are in private industry. Membership is open to anyone who supports the vision and mission of AWIS. The association has two programs that focus on promoting women in technology in the private sector: Women in Advanced Manufacturing and Talent and Leadership Development. Women in Advanced Manufacturing advocates for and promotes the roles of women in manufacturing, offers professional development opportunities, and provides training on implicit bias to manufacturing companies, particularly since manufacturing pays 17 percent better than other industries. It also researches disparities that affect women in the technology sector: for example, women in the United States represent 25 percent of STEM professionals, but hold less than 10 percent of all patents. The Talent and Leadership Development program offers mentoring, coaching, and leadership opportunities so women can continue to grow throughout their career. Membership costs $65 to $1,000.
Recruitment	
United States / Worldwide	**Pacesetters.** The National Center for Women in Information Technology (NCWIT) Pacesetters helps companies change their organizations by setting aggressive and measurable goals over a two-year timeframe. These goals include challenging stereotypes that discourage positive behaviors, improving internal processes, and advancing technical innovation. Pacesetters practice disruptive thinking that leads to breakthroughs in the way things have always been done and they have achieved significant results." Pacesetter organizations have added or retained 2,650 women in the U.S. computing workforce, and several NCWIT member companies have led the initial charge for data transparency, publicly releasing their diversity numbers and setting a historic example for others to follow. Although individual organizational goals are held confidential, the following are a few examples: • One major tech company doubled its number of female engineer interns. • A well-known company piloted a highly successful workshop for over 100 mid-career female technologists to learn how to command presence in executive environments.

	• One university doubled the number of women in its undergraduate programs from 75 to 150 in the first cohort and then doubled it again in the next from 150 to 300. • Another university established a new B.A. of Computer Science degree that is attracting double majors in the areas of neuroscience, philosophy, GIS, economics, film, and more. Through Pacesetters, company and university leaders work together across corporate, startup and academic boundaries to incubate innovative ideas for broad impact. In 2010, Pacesetters influenced the inception of Sit With Me, a domestic advocacy campaign to raise the visibility of technical women and their valuable contributions. In 2014, Pacesetters led an experiment called "Transforming Technical Job Ads" to leverage their university-corporate partnerships by co- writing inclusive job ads to attract a more diverse technical talent pool.
United States	**Diversity and Inclusion Council. Gulfstream Aerospace**. A subsidiary of General Dynamics, Gulfstream designs, develops, manufactures, markets, and services business jet aircraft. The company employs of 15,000 people worldwide. In 2008, Gulfstream launched its internal Diversity and Inclusion Council to accelerate and bolster efforts to create a fully engaged workforce that support opportunities for all employees. The council has four primary objectives: foster an inclusive environment, promote employee engagement and business unit ownership, solidify the business case for why diversity is beneficial in the global marketplace, and embed diversity into the organization. The program has three levels of engagement for employees: member, champion, and ambassador. Members liaise between their business unit and the council, while champions and ambassadors liaise with the council and Gulfstream leadership and volunteer to assist with council programming. Council programming could include: speaker series, books, recognition dinners, employee resource group discussion, and a certification course in diversity and inclusion. In 2014, over 20 percent of Gulfstream's employees participated in council activities. The council provides an enterprise-wide agenda to advance employee diversity to foster a workforce focused on collaboration and build effective managerial leadership opportunities.
Retention	
Australia	**Science in Australia Gender Equity (SAGE)**. Motivated by the Athena SWAN Charter, and a persistent cavity in the representation of women in the fields of Science, Technology, Engineering, Mathematics and Medicine (STEMM), the Australian Academy of Science ("the Academy") piloted the SAGE program in 2015 to address gender equity and diversity in those fields. Alongside consequent partnership of the Australian Academy of Technology and Engineering (ATSE), the SAGE pilot now boosts 40 charter members including 30 universities, six medical research institutes and four government science organizations. In September 2015, participants of the pilot were required to collect, analyze and present data on gender equity policies and practices in STEMM departments, as well as identify gaps and opportunities for improvement. This was done in an effort to motivate participants to work toward meeting Athena SWAN's international recognized standard of "improving institutional capacity to eliminate gender inequity and demonstrating commitment to bolster the hiring, promotion and retention of women, while also improving the workplace environment for people of all genders". In March 2016, the SAGE Expert Advisory Group was formed to provide expert strategic and gender equity advice to the SAGE Executive Management Board and Executive Director in supporting a successful implementation and evaluation of the SAGE pilot of the Athena SWAN Charter.
Japan	**Private-sector support for women researchers.** A manufacturer of cosmetic products and other consumer goods, the Shiseido Group provides three different funding opportunities to qualifying women: the Shiseido Female Researcher Science Grant, the JSID Shiseido Fellowship Award, and the Japanese Dermatological Association Basic Medical Research Grant.Shiseido also specific technical assistance projects undertaken by female junior high school students to advance women as scientific experts in Japan, including discussions about the possibilities in STEM education and occupations.

Chinese Taipei	**Work-life balance initiative.** The Ministry of Labor in Chinese Taipei encourages enterprises to promote work-life balance for workers in three fields: (1) autonomy and accomplishment in work; (2) care and family support; and (3) physical and mental health and safety. Methods advocated by the Ministry to promote work-life balance include the following: • Sponsoring enterprises to provide work-life balance: 161 businesses were sponsored for NT 5.8million in 2015, to conduct employee stress relief lectures, employee care courses, family-friendly measures and temporary childcare spaces, 70,000 workers and their families achieve a balance between work and family life. • Organizing the "Work-Life Balance Award" ceremony, where best practices were commended to promote the philosophy and benefit of work-life balance. • Holding 24 promotional events in 2015, with participation from 2,123 enterprises representatives. These events increased knowledge and skills to promote work-life balances activities in the workplace.
United States	**The STEM Re-entry Task Force.** Created by Society of Women Engineers (SWE) and the re-entry firm iRelaunch, the Taskforce provides reentry internships for women job seekers with technical degrees. The program is also designed to produce structural change in the STEM sector by using the internship as a vehicle for engaging with returning technical job seekers. Seven companies from SWE's Corporate Partnership Council have stepped forward as the Task Force Founding Members: Booz Allen Hamilton, Caterpillar Inc., Cummins Inc., General Motors, IBM, Intel Corporation and Johnson Controls. Each Founding Member has committed to pilot a re-entry internship program during 2015-2016. Pilot programs were launched in January 2016, with founding members making selections for permanent positions during April 2016.
Leadership and Advancement	
Australia	**AusBiotech Advancing Women Program.** This program runs for six-month cycles and is tailored to the biotech/life sciences sector. Extensive research and industry consultation identified factors and challenges within the sector. The program was then designed for emerging female leaders, equipping them with the skills to progress successfully in their industries. The course consists of a group workshop series (4 workshops); guest speakers from both corporate and research backgrounds; individual coaching; and a career advancement plan.
Australia	**Women in Science, Australia.** Founded in 2014, this non-profit organization aims to connect women in Science, Technology, Engineering, Mathematics and Medicine across profession sectors including- education, research, industry, academic and government. The organization collaborates with a number of organization and groups in order to strengthen STEM in Australia particularly focusing on leadership, decision-making and senior positions. The organization's website boasts an active community that regularly shares, endorses and supports domestic as well as global events, initiatives and conferences for their vast membership.
Canada	**Women in Communications & Technology (WCT).** Established in 1991, WCT works to advance women in careers in communications, digital media and technology through "a coast to coast community network of industry support, leadership, education and mentoring." Headquartered in Ottawa, WCT empowers women in broadcasting, cable, telecommunications, digital media and technology to achieve professional success, to aim higher and to be recognized for their achievements through partnerships with organizations such as Information Communications Technology Council. Information Technology Alliance of Canada and Wired Women. WCT offers its members and extensive array of programs which include both one-on- one and cross-company mentoring; digital skills learning programs, including professional development webinars and online learning (created in consultation with the Ontario Ministry of Training, Colleges and Universities); and a Protégé Project, which includes Senior Professional Women's Events that enable

	for mid to senior level managers to meet and network outside their company environment to network amongst senior professional women in executive roles in telecommunications, media and technology sectors. WCT also presents Leadership Excellence Awards (LEA) which recognize and celebrate outstanding women in the fields of communications and technology. The awards include 8 Award Categories: Company of the Year; Woman of the Year; Trailblazer; Mentor; Public Sector; Innovator; Technology Innovator.
Worldwide	**The Chevron Way: Engineering Opportunities for Women**. This internal program is designed to strengthen the Chevron company by attracting, retaining, developing, and advancing women throughout the company. The Chevron Way is the primary driver of the company's diversity strategy and comprises a variety of programs, processes, and tools to facilitate gender inclusion, such as targeted recruitment, leadership development, employee networks, and mentoring/sponsorship. Chevron offers a number of corporate leadership development programs that support women's advancement, including the Emerging Leaders Program, Chevron Leadership Forum, and Chevron Advanced Management Program (CHAMP). Chevron's 12 Employee Networks each have an executive sponsor and a yearly plan linked to business objectives, including a return on investment component. Furthermore, the Employee Networks and some of Chevron's leadership development programs provide opportunities for formal and informal mentoring. The Women's Network features a global mentoring program with an extensive matching process. Finally, the initiative emphasizes accountability by tying diversity goals, which include gender, to performance for nearly all employees.
Russia	**PWC Russia – Women Leaders in Russia Business initiative.** Since 2007, PwC Russia, the economy's branch of the international consulting firm, has conducted periodic surveys of large firms (both Russian-owned and international, employing an average of 8200 workers) pertaining to women's opportunities for career growth in the Russian Federation. The purpose of the surveys, according to PWC Russia, is to help women achieve their full career potential. Survey questions are oriented toward general conditions for working women at large firms, as well as various aspects of female leadership, including its nature, the most the important qualities for women leaders, and competitive advantages of women. The PWC studies identify limiting factors and the key impulses for career growth. In one survey, PWC found that, between 2008 and 2012, women observed significant growth in the proportion of women holding key posts such as CEO and CFO. It further found that women are generally more loyal to their employers, less inclined to change their place of employment, more industrious and willing to work for lower pay. Still, just 10% of the 82 companies surveyed offer career development programs or have strategies in place for the women they employ. Increasingly, the survey found, companies offer women one- off payments on their return from maternity leave. Finally, almost half those surveyed said they view work schedules for employees with young children as the most pressing issue.
Entrepreneurship	
Skills and Opportunities	
Australia	**Female Founders.** This popular program enables and supports both women who are considering or currently running their own business, and students that are soon to choose their career path. Female Founders runs two initiatives: (a) Female Founder Series, a set of workshops and/or seminars co-created with female founders, entrepreneurs and tech professionals. These are on ambitious thinking; the funding landscapes; emotion and business; and growth and the essentials of scale. There is also a six-month mentorship program designed to empower female founders; and (b) Here to There, a program that aims to enlighten the career path for teenage girls who are thinking about a career in entrepreneurship by giving practical training in entrepreneurship to girls through school visits, weekend workshops and other events and tailored support.

Chile	**The "S Factory."** Chile's government sponsors the S Factory, which is open to women and has an approximate budget of USD 690.000 (460 million Chilean pesos). The program supports women who are developing startups with high growth potential. The beneficiaries receive approximately 15,000 (US, or 10 million Chilean pesos) and have the opportunity, during a 12-week period, to meet with vibrant entrepreneurs from all over the world in a multicultural and collaborative workspace and access learning opportunities through courses, mentorships, and pitch training, among others.
Chinese Taipei	**SME-eLearning big School.** Led by the Small and Medium Enterprise Administration alongside the Information Service Industry Association of R.O.C., Chinese Taipei's representative body of information service industries, the "SME-eLearning big School", which was launched in 2003, is recognized as a leader in providing e-learning developed specifically for small and medium enterprises in Asia. With more than 1,100 free online courses in six categories, the program has provided support to over 470,000 SME employers and employees. The website is free and open for enrollment to anyone.
Peru	**Women in Technology.** Started in 2013, Women in Technology encourages women's participation in technology and the technology-based entrepreneurial ecosystem. The group has organized events 15 events since the launch, with over 350 attendees. As of 2014, WIT has 745 members and 1,500 Facebook followers, and has garnered support from Python Software Corporation to send female students on scholarship to the United States. WIT also implements Coderise, an eight-week program on technology and entrepreneurship for teenage girls. WIT also organizes Women Startup Weekend Lima, where women can take a weekend to develop and gather feedback on a business idea and learn about entrepreneurship overall.
Peru	**Women@theFrontier (W@F).** W@F is a nonprofit social venture and network of women entrepreneurs, leaders and technology entrepreneurs. W@F has a three-step mission to find women role models, fuel change through events and gatherings, and fund new ventures by connecting innovators and entrepreneurs through the W@F Mentor Marketplace. W@F held events in Lima in 2013 and 2014, gathering 30 women entrepreneurs and leaders in 2013 to highlight the work of women technology designers.
Republic of Korea	**Korea IT Business Women's Association (KIBWA).** Established in 2001, KIBWA supports woman-owned SMEs in the ICT sector as well as greater competitiveness of these businesses through development of resources for women. The association connects women in the sector, introducing them to leaders and role models. The association has three branches: in Seoul, Daegu/Gyeongbuk and in Gyeonggi. Specific activities include hosting conferences for women in ICT and holding competitions for creative problem-solving. KIBWA also manages a mentoring project to support female students who are studying science and engineering and also supports Girls in ICT Day by holding a workshop session on "How to Launch ICT Venture Business." The association also builds cross-border connectivity for women in ICT in collaboration with the Trade Association of Information Technology and the Mobile Technology Convergence Centre. This project explores opportunities for technical and marketing cooperation between Indian and Korean businesses in ICT.
United States	**Women in Technology and Entrepreneurship in New York.** This initiative strives to facilitate, encourage and enable a significant increase in the participation of women in both higher education and entrepreneurship in fields related to technology in the New York market. Through strategic initiatives and purposeful integration with key institutions and programs in the city of New York, Winy targets high school girls getting ready for college, undergraduate and graduate women, preparing them to secure a rewarding and lucrative position in the technology industry.
Access to Capital	
New	**ArcAngels.** A member-based angel investment organization, ArcAngels focuses on building

Zealand	investor knowledge and investing in early-stage businesses that are led or managed by women in New Zealand. ArcAngels focuses on for-profit organizations with a female founder or leader or a woman in an executive management position. Sometimes an organization will be considered if it was founded by or is led by a diverse management team. The organization "should have a scalable product or service, proven customer base, albeit small, and a validated business model." ArcAngels is most interested (but not solely) in businesses in the following sectors: IT and communications (digital, media, mobile and web); clean tech and renewable energy; biotech; medical devices; food and beverage; financial services; and agriculture.
United States	**Women's Venture Capital Fund.** Established in 2011, this fund supports women-owned and/or run high-growth companies in digital media. One of the largest untapped market opportunities is the creation of digital media products for women and families, one of the largest market segments. Other venture funds do not target this market, leaving an opening for the Women's Venture Capital Fund to invest in mobile technology to help women stay connected and informed. The Fund also has an investment focus on environmentally friendly services and products.
Access to Markets	
Malaysia	**E-Entrepreneurs Women's Association.** With a mission to "empower women entrepreneurs with ICT," EWA's objectives are to: (1) Connect Malaysian women entrepreneurs who are involved in online business; (2) support women entrepreneurs' use of online business; (3) train members to use ICT for business productivity; (4) support members through activities; and (5) participate in studies and working papers related to EWA's mission; and (6) work with the government to advance EWA's mission. Membership costs RM 45 (US$12) and is open to all Malaysian women who own an online business. EWA runs an e-entrepreneurs Women Trade Centre. This is an online marketplace for members to sell their products. Products available include food, handicrafts, and fashion items. Other activities include an E-incubator project led by the president of EWA and funded by the Ministry of Science, Technology, and Innovation.